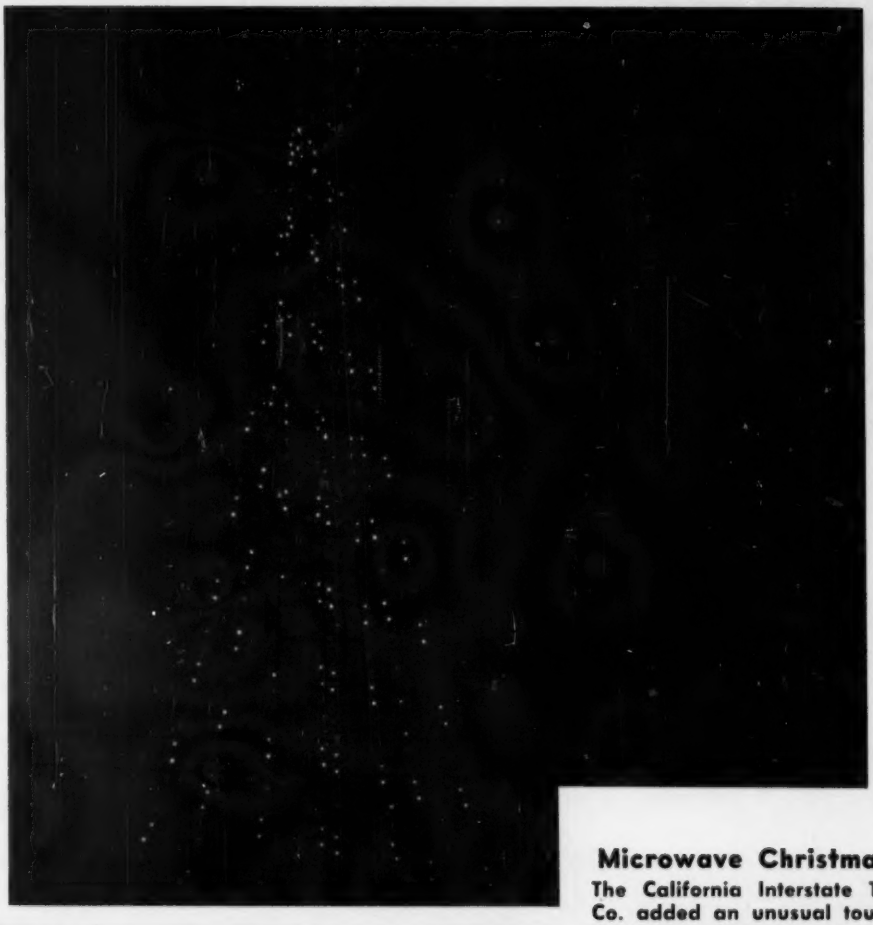
DECEMBER 26, 1959
VOL. 157 — NO. 26

Telephony

THE JOURNAL OF THE
TELEPHONE INDUSTRY
SINCE 1901



Microwave Christmas Tree

The California Interstate Telephone Co. added an unusual touch to the Christmas observance in Victorville, Cal., by converting its microwave tower into a giant Christmas tree with 400 colored lights. See page 20.

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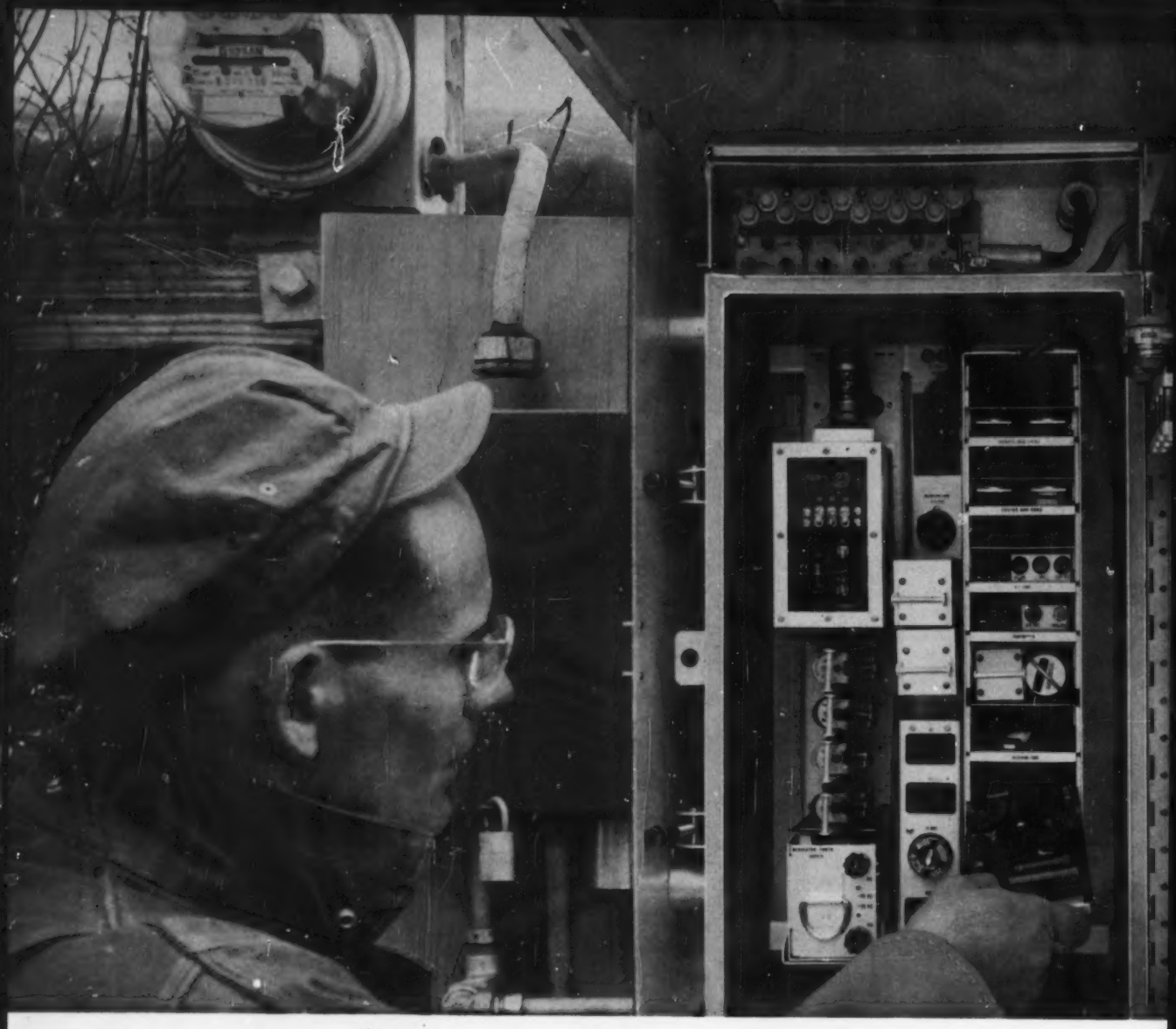

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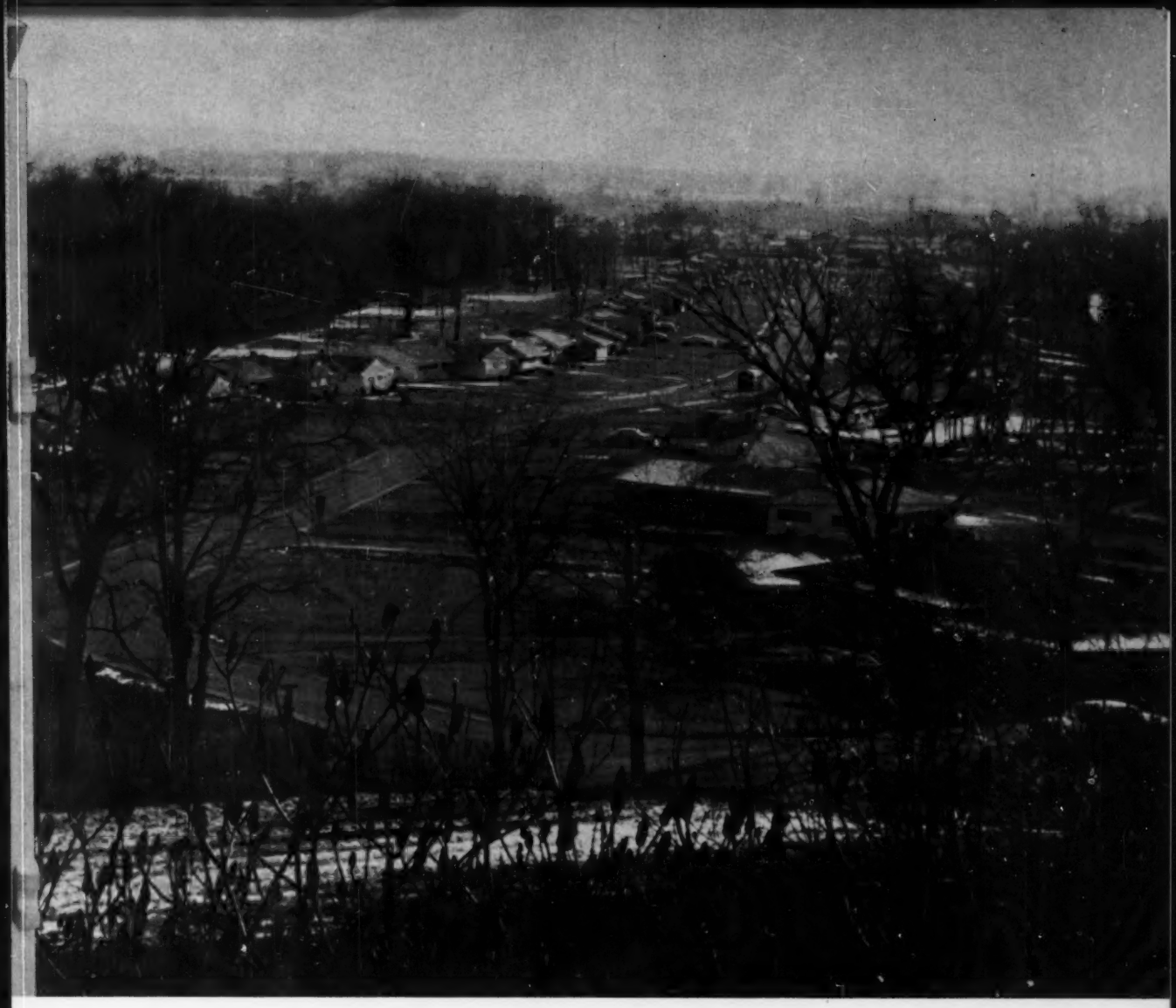

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FLASHES AND PLUGS

TELEPHONE RECOVERS LOST DOGGIE. Phil Flattery, of the Independent Company Relations Department of the Ohio Bell Telephone Co., tells this story about Cracker, a pet cocker who joined the family on July 4, 1950.

As the years rolled by, Cracker progressively lost his eyesight until he became practically blind. The daughters of the family left the little nest and Phyllis, the apple of Cracker's eye (if he could see) landed in Burlington, Vt.

This summer, came a momentous decision. Cracker would go to Vermont. When Phyllis and Cracker left for Vermont, Cracker kept his collar with his Columbus telephone number.

Three weeks later, the telephone rang in the Flattery home in Columbus. The conversation went like this.

"Long Distance calling collect from Norwich, Vt."
"Don't know anybody there, sure you want me?"
"Are you Phil Flattery?"
"Yes."
"I want you."

The 1,000-mile call was accepted.

"I've a dog with your telephone number on his collar."
"Is he blind?"
"Yep, he just wandered by my gas station and I took him in."
"Please hold him until I call my daughter. Is Norwich near Burlington?"
"No, it's 75 miles away!"

The telephone swung into action. No answer at her telephone, no answer at her boss's, no answer from her old room-mates.

Finally two hours later, operators found she was visiting "Do" at her father-in-law's summer home—no last name, no telephone number.

Poor blind Cracker in a strange land waited patiently while telephone people worked. Supervisors took over. Telephones were called in Norwich and finally, a frantic Phyllis was located. A thousand-mile telephone call informed her that her lost dog was waiting for her a quarter of a mile down the road!

The moral, Mr. Flattery says, is this: If you have an old blind dog by the name of Cracker that tours the country in his old age, put your telephone number on his collar. The telephone company will get him back.

•

SPACE CADETS? They seem already to be living in the space age out at the Allis-Chalmers Co., the *Milwaukee Journal* reports.

Malcolm Maloney, in steam turbine advertising, found a memo on his desk to call Clarence Hansen, head of the photo lab, at "X-457," the "X" standing, of course, for Mr. Hansen's telephone extension. Mr. Maloney dialed the number.

"Is this X457?" he asked. "This is X-774 calling."

"When are we going to blast off?" retorted Hansen.

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Telephony

THE JOURNAL OF THE TELEPHONE INDUSTRY
Since 1901

December 26, 1959

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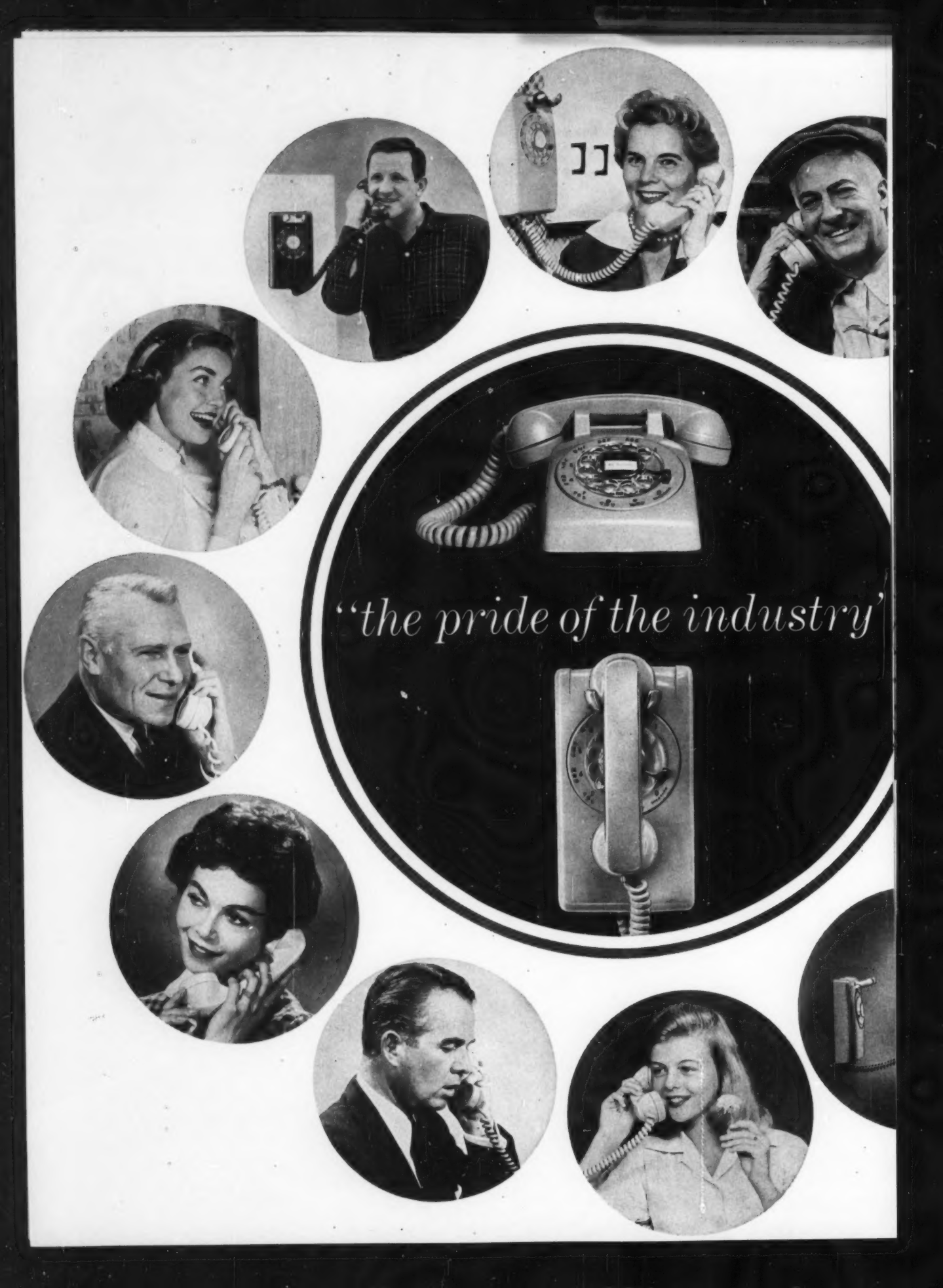
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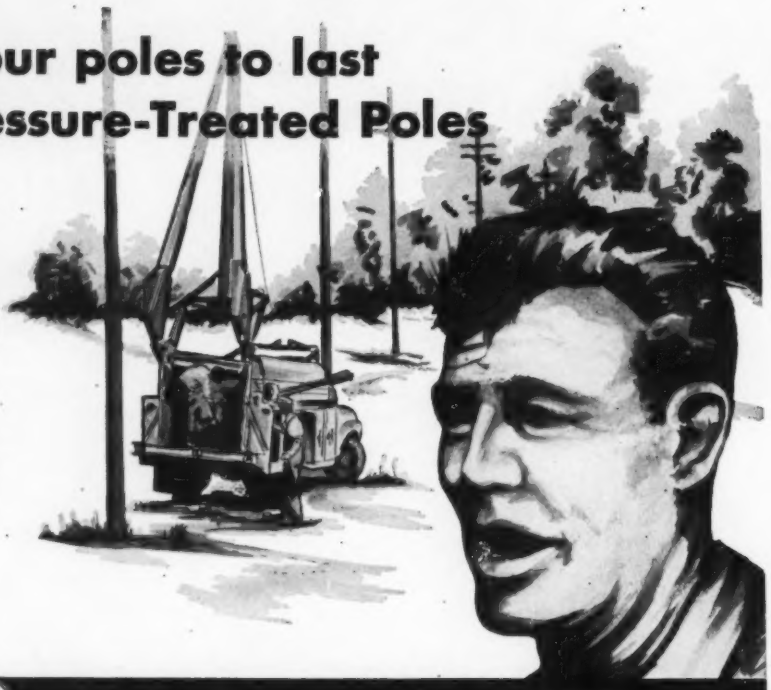

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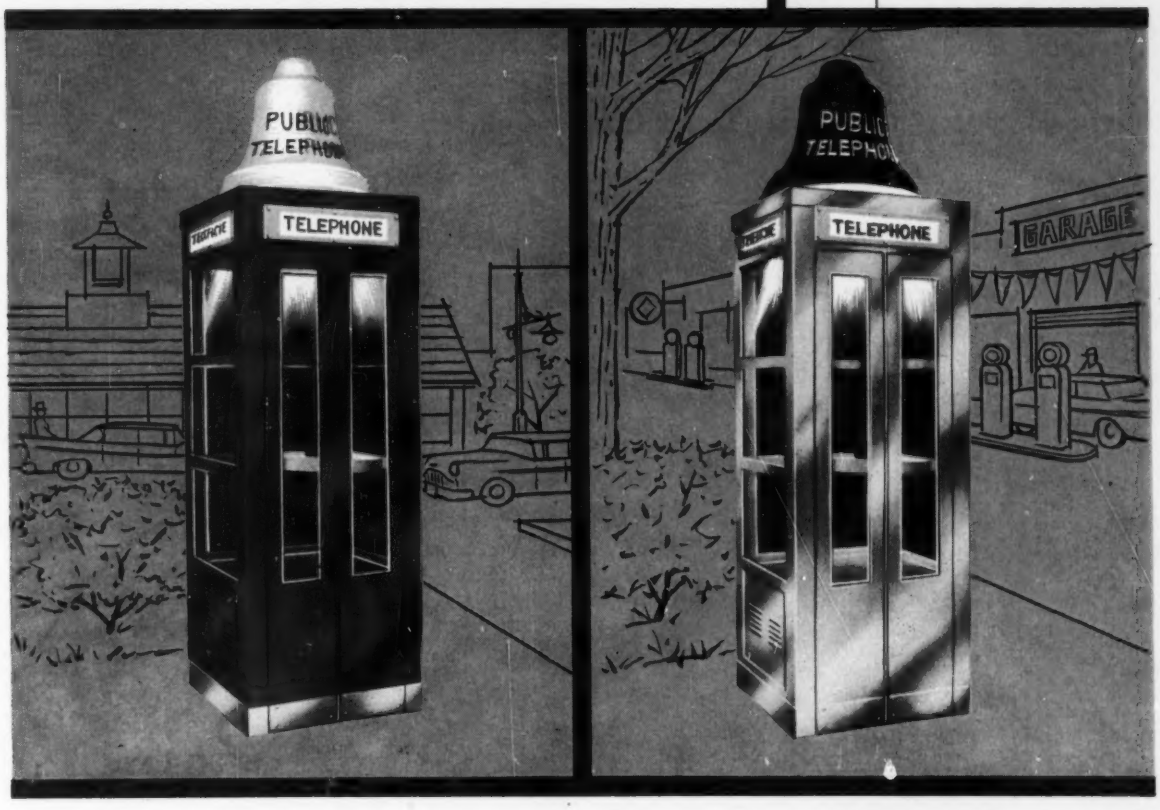

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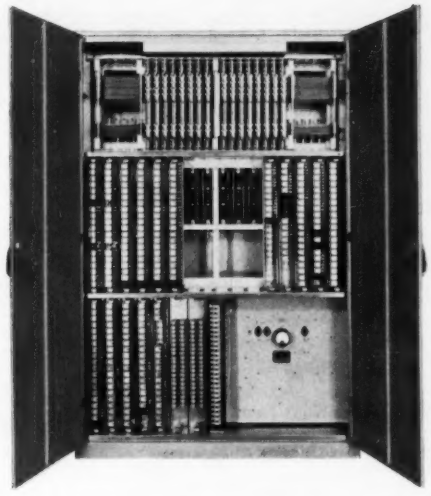

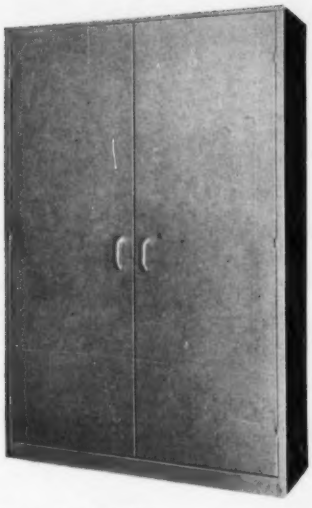

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IN THE NATION'S CAPITAL

BY FRANCIS X. WELCH, WASHINGTON EDITOR
AND EDITOR, PUBLIC UTILITIES FORTNIGHTLY

What's ahead for 1960 in (1) Regulatory Reform; (2) Cases Before the FCC; (3) Political Campaign Oratory. Scored 7 out of 10 on 1959 predictions.

ONCE AGAIN we come to the year-end holiday season with its usual exchange of greetings and wishes for peace on earth and good-will. This department, in checking over the predictions made a year ago about what would happen to the telephone companies and other utilities on various matters of interest, in and out of Washington, finds the actual results a little under par—three wrong.

For the coming year your correspondent has decided to depart from the pattern of making 10 flat predictions. The reason is that this involves so many repetitious items from year to year (such as rate case activity, minimum wage law action, and tax legislation, if any). There is not much sense in repeating guesses on these hardy perennials, whether right or wrong for particular years.

And so for 1960 your Washington editor would like to shape his comment along lines he feels will focus on important things to look for during the coming year, regardless of any arbitrary number of items.

Regulatory Reform

Perhaps the most important single matter looming on the Washington horizon for 1960 is the demands for procedural reform or possible changes in the set-up of our federal commissions, notably the Federal Communications Commission. This agitation, of course, has been the outgrowth of the investigation activity of the House Legislative Oversight Sub-committee, headed by Representative Harris (D., Ark.).

At the outset it should be noted that this sub-committee has done some fine work in the public interest. Contrary to the earlier expectations of some, including this writer, the Harris group has not been vindictive or unfair in its revelations of shortcomings in the work of our federal commissions.

It might be accused of headline hunting in the light of such sensational disclosures as the rigged television quiz program scandal, or the radio "payola" developments. Yet, that is reasonably to be expected from any congressional investigation because of the necessary political approach. But it must be conceded that the House group has uncovered shortcomings which needed to to uncovered. And if the public has been shocked by some of these revelations, it has probably been a good thing.

The very fact that both the Federal Communications Commission (FCC) and the Federal Trade Commission (FTC) have been pressured into making investigations of their own into allied fields of commercial radio and television broadcasting, is the best evidence that the Harris group rang the alarm bell first.

The spectacular nature of some of these revelations should not, however, distract people in the public utility field from considering a more significant aspect of the House sub-committee work. There is the good possibility that out of this investigation will eventually come congressional legislation which could have an impact on the future organization and operation of *all* federal commissions, and upon the regulation of *all* utilities at the federal level.

Bills already pending in Congress, and other proposals made in the wake of the House sub-committee hearings, range from suggestions for minor changes in procedure to outright abolition of federal commissions.

What will Congress do about this? Well it has to do something. Otherwise the Harris sub-committee will not have anything to show for its well-publicized efforts during the coming year. This writer is inclined to the view, however, that Chairman Harris and most of his sub-committee will not act hastily on sweeping radical or short-sighted measures. And, by the same token, it is believed that any bill which will be enacted during the coming session of Congress will be limited in its application to procedural reform, such as the bill advocated by the American Bar Association to prevent improper contact between regulated industrial interests and members of the commissions, their examiners or staff. There probably won't be too much argument about this general principle of ethical conduct, although the practicing lawyers will want to view developments closely to see that no unwise or crippling side effects would result from such legislation.

As for doing away with the federal commissions' authority altogether, along the lines proposed by a former member of the Civil Aeronautics Board, this writer believes that the House Interstate and Foreign Commerce Committee, headed by Chairman Harris, has too much common sense to embrace any such disruptive proposals in the first place. And, if by chance, the committee and the two chambers of Congress did approve, President Eisenhower would

certainly veto. But, actually, the likelihood of anything like that getting out of committee does not seem very strong.

Cases Before the FCC

While the Federal Communications Commission continues to be in the spotlight of congressional investigations with respect to radio and television broadcasting practices, the telephone-telegraph end of its jurisdictional business is not particularly weighed down with cases slated for decision in the months ahead. But there are two rather important cases in this category; perhaps their importance outweighs the numerical scarcity of telephone-telegraph cases as a class.

The first of these is the FCC private line rate investigation which has been going on for some time but which is now moving towards a conclusion before FCC Examiner J. D. Bond. The FCC Common Carrier Bureau has suggested that Examiner Bond strive for an early FCC decision. The case involves filed tariffs by both the American Telephone & Telegraph Co. and Western Union Telegraph Co. for private line service.

What makes this case so complex is that factors which normally affect the determination of rates for earnings of regulated utility services do not necessarily apply to the private line services under investigation by the FCC. These services are supplied in the same market by two producers instead of one—the telephone company and Western Union. This is a market situation which economists call "duopoly." Company witnesses have contended that it is a wholesome situation to have such competition, even though one of the carriers may fare somewhat better than the other. But, in any event, such a market situation seems to call for a flexibility in price policy without necessary conformity with the average rate of earnings for either the telephone company or the telegraph company as a whole.

The forthcoming decision of the FCC will determine whether the commission will go along with approval of flexible pricing policy under such circumstances for the private line services. Telephone companies' price objectives, as summarized by AT&T Assistant Vice President Harold M. Botkin, were as follows: (1) Adequate and stable revenues; (2) incentive to customer usage; (3) rates consistent with the value of service to the customers, including the cost of alternative services; (4) simplicity, and (5) adequacy to cover cost, but not necessarily limited to cost for each class of service.

The telephone industry believes there is a great future for private line services which have been growing at the annual rate of 17 per cent for the past decade—three times the rate of expansion for the national economy as a whole.

Among other complicating factors in the private line service investigation is the position taken by the Comptroller General on behalf of the the use of such services by the federal agencies. The General Accounting Office takes the position that the federal government is entitled to certain automatic price

(Continued on page 45)

Welch Got Three Wrong in 1959

In the following box score of the results on his predictions for 1959, published in this department of TELEPHONY (Dec. 27, 1958), Welch scores himself as having three wrong.

(1) **Acquisition Policy.** Predicted that the Bell System and the United States Independent Telephone Association would reach a top-level agreement on acquisition policy and that the FCC would affirm the examiner's opinion approving Wisconsin Bell's acquisition in the Menomonee Falls case.

Wrong. Right about the Menomonee Falls decision.

(2) **Public Mobile Radio-telephone.** Predicted that the FCC would allocate additional frequencies to public radio-telephone service and otherwise reorganize spectrum allocations.

Wrong.

(3) **Lease-Maintenance Mobile Service.** Predicted that the FCC would decide that proposed lease-maintenance tariffs could not be approved within the Western Electric anti-trust consent decree.

Right. At least Bell asked to withdraw tariffs.

(4) **House Judiciary Committee Activity.** Further criticisms by the House Judiciary's Anti-trust Subcommittee, headed by Representative Celler (D., N. Y.), of the alleged monopolistic activities in the telephone field was forecast.

Right. It did not amount to much; but a critical staff report was released by Chairman Celler in May, hitting the consent decree.

(5) **House Legislative Oversight Activities.** Further investigating activity by the sub-committee into the FCC and other commissions was forecast along with the extension of the sub-committee for another year.

Right.

(6) **Labor Legislation.** Predicted the increase in minimum wage, the loss of small exchange telephone operator wage exemption, and the failure of labor legislation.

Wrong on all three points!

(7) **REA Rural Telephone Loan Program.** Predictions were made that Ike would propose an increase in the 2 per cent REA interest rate and that Congress would attempt to free REA from Agriculture Department's money control—and that both tries would be unsuccessful.

Right on both counts.

(8) **Rate Case Activity.** A continuation of rate case activity but very few state legislative developments affecting telephone regulation were forecast.

Right.

(9) **Highway Relocation.** Court litigation rather than new legislation was seen as the dominating development during the year.

Right. Constitutionality of such laws has been questioned in eight states and knocked out in three.

(10) **Accelerated Depreciation.** More public utility companies were seen switching from accelerated depreciation to the conventional straight-line method for tax purposes.

Right. There is still a conflict of rulings on utility benefits from fast depreciation.

Bonus Prediction: That Congress would not kill or cut the 10 per cent excise tax.

This was right, although a termination date on June 30, 1960 was enacted.

T.O.P.* TOPICS

By WINNIE B. BURNETT

Part 3

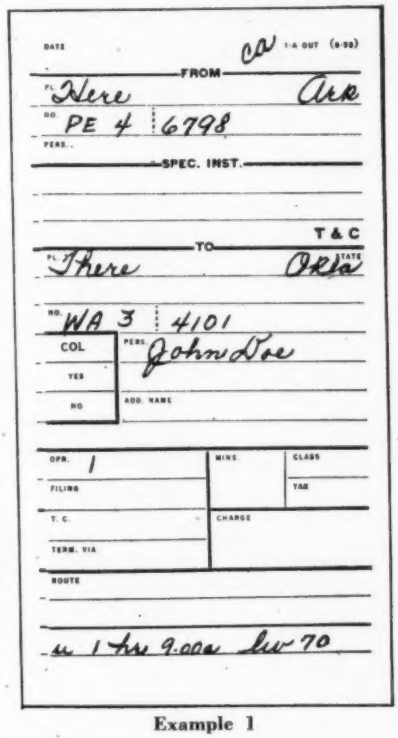
Another Change — A Step Toward Better Service

IT HAS been said that the only difference between a rut and the grave is the depth—so beware of the rut. There doesn't seem to be much danger of people in the exciting work of telephony getting in a rut, because an established mode of procedure is now a temporary thing. And this is to the good if the change of procedure improves service.

The new practice concerning leave-word WH party calls simplifies the method of handling such reports to provide faster, more efficient service to the customers. The delayed ticket position has been eliminated as have all procedures for handling miscellaneous requests for details at the ticket positions. In line with this, WH calls will be completed at the originating toll center without reference to the original ticket in any case.

The new practice calls for a uniform arrangement of the leave-word WH trunks to appear on a single common trunk group in the answering multiple. Separate identity leave-word numbers should be established for the different types of calls. In our company, the following leave-word numbers are used:

Opr. 30—Third station calls.
Opr. 40—Collect calls.
Opr. 50—Special (nfy, do not monitor, mg, appt, etc.).



Example 1

Opr. 60—Quote T and C.
Opr. 70—Regular calls requiring no special action.
Opr. 80—Credit card calls.
Opr. 90—Coin telephone calls.

It is necessary that these leave-word numbers be posted conspicuously at each position, and that the operators be particularly attentive to the WH operator number as passed.

In the following paragraphs, detailed instructions for operators' work are given.

If a report of delay is received on the called party, say to the calling party, "Shall I leave word or would you prefer to place your call again?" If he will place his call again, cancel the ticket.

If he will place his call again, but word is left, say, "I'll call you when (cld. pty.) reports. However, if he does not report, will you place your call again?" *Cancel* the ticket. No voluntary subsequent attempts are made (See *Example 1).*

If word is left, *but the calling party wishes you to make a subsequent attempt,* enter the attempt time on the ticket and hold it at your position for subsequent attempt.

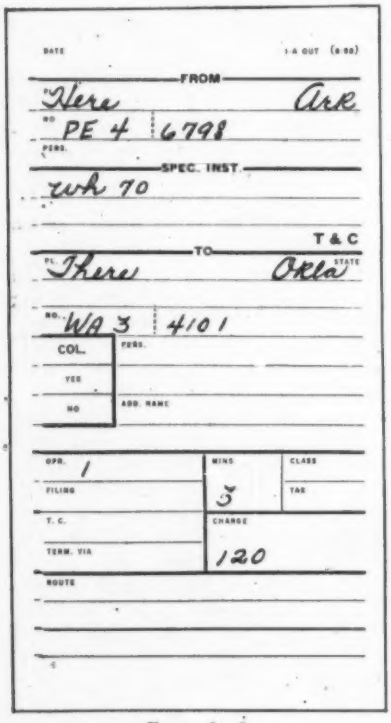
*Traffic Operating Practice

If the calling party asks you to hold the call until he tells you to try it, say, "It will be better if you place the call again when you are ready." Explain, if necessary, that the operator will try the call at once when he places the call, which will result in a faster connection than if she were to try to find the original ticket.

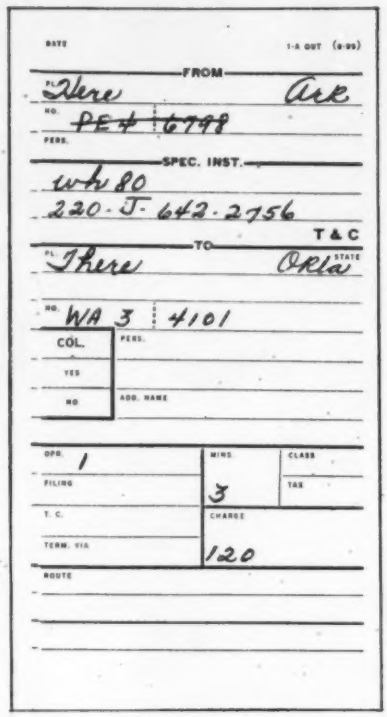
If the calling party wishes you to make a subsequent attempt, but says he will talk from another telephone which is not served by your office, explain that it will be better to place the call later from the other telephone.

When you answer a recording signal, if a customer refers to a previous call and indicates that he wishes to have the call tried again or requests a report, ask for the call details saying for example, "If you will give me the call again, I will try it for you now." Record a new ticket, enter "AG" in the "Spec. Inst." space and proceed as on a new call. At the end of a conversation, file the ticket with the completed tickets. If you encounter delay and the call remains active, hold the ticket at your position.

If a customer asks for an operator by number, say, "This is (opr. no.)" and proceed as above, unless the "Special" leave-word number was requested. In that case ask, "What special directions did you give the operator when you placed the call?" and proceed as indicated.



Example 2



Example 3

The new practice provides for completing WH reports without referring to the original ticket in any case. Anytime a delay is encountered in reaching the calling line or party, hold the ticket for any subsequent work at your position. All WH reports will be received over a common LEAVE-WORD TRUNK group. In order for you to easily identify the type of call, identifying leave word numbers will be assigned.

When you answer a LEAVE-WORD TRUNK signal, say, "(Name of your ofc.)," without specifying any operator number. Record the information passed by the TTC operator in the usual manner. In addition, the TTC will pass you the leave-word number which will be entered following "WH" in the "Spec. Inst." space.

Say to the called party, "This is operator (WH no. psd. by TTC) at (your ofc. name). May I have your number and name, please?" and enter the details in the proper "To" spaces. Then ask, "Mr. (Cld. pty.), what is the calling telephone number left by the operator?" If the number is furnished and the WH number passed by the TTC is for a *regular call*, establish the connection (See *Example 2*). If the leave-word number indicates the call requires special attention, proceed according to the action necessary.

If the leave-word number indicates a credit card call, say, "May I have the credit card number again, please?" (See *Example 3*).

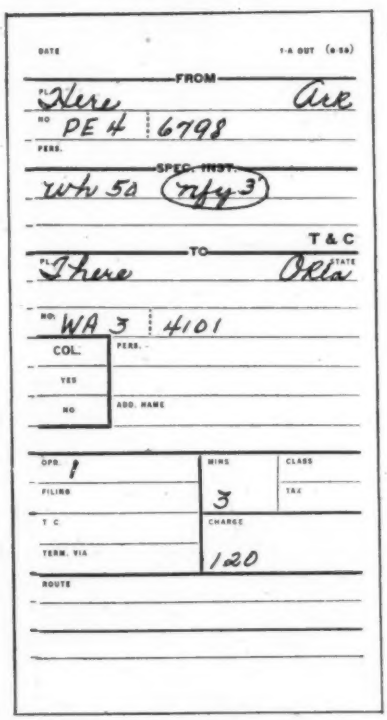
If the "Special" leave-word number is passed, ask, "What special directions did you give the operator when you placed the call?" This will include such cases as "do not monitor," "nfy," "appointment," "mg," etc. Enter the special directions and proceed to establish the connection (See *Example 4*).

When the call is disposed of, file the ticket with the other completed or canceled tickets. Under the new practice there will be no delayed ticket position. Any delayed ticket, such as BY, DA, NC, OD, Ext. BY, Room DA, etc., will be held at your position until completed or canceled. The operator who records the call will be responsible for any subsequent attempts required on such tickets.

The phrase for reporting a WH to the OTC operator is "(Cld. pl.) calling operator (no.), WH on line." Care should be taken to obtain and pass the correct operator number, since this information identifies the type of call to the OTC operator.

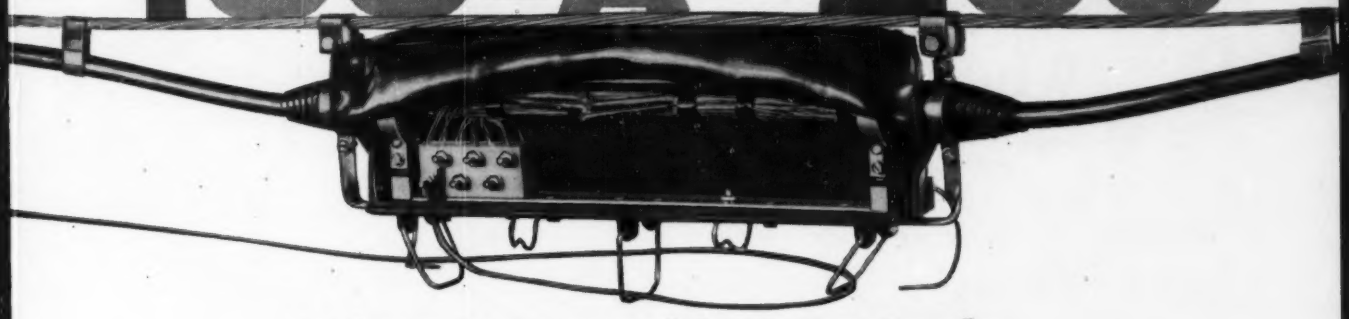
With the sonic booms reverberating along the sound waves (and in our eardrums), we are ever reminded of the necessity for speed. But only with safety and accuracy is any increase in speed warranted. Along with our supersonic speed, let's always take the old-fashioned twins — Courtesy and Accuracy.

(To Be Continued)



Example 4

100-A • 200



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Wheatstone Bridge Measurements

By JOHN A. BRACKEN

Part 6

WHEN THE Wheatstone Bridge is used for locating faults in telephone cables, it is common practice to apply what is known as the "Three Varley Test," consisting of a series of three measurements—Varley 1, Varley 2, and Varley 3. The first two measurements are necessary to obtain the resistance in ohms to the fault from the distant end of the cable, while the third measurement gives the resistance from the testing point to the fault and serves as a check against the accuracy of the first and second measurements.

The Three Varley Test has a definite advantage, in that any wires or cords used to establish the test connections between the Wheatstone Bridge and faulty cable conductor neither need to be known or allowed for in calculating the location of the fault, because their resistance is automatically subtracted.

The principal drawback, if it can be called such, to using the Three Varley Test method lies in the fact that, in order to make the measurements, a good cable pair is required in addition to the bad pair.

The good cable pair used in making the test can be unequal in size and resistance to the bad pair within reasonable limits, because its resistance balances out. By reasonable limits is meant that the good pair should not be considerably less in resistance than the bad pair. It should preferably have a loop resistance equal to or greater than that of the bad pair.

Another way is to use a good pair in another cable which follows the same route as the cable containing the fault. The method of connecting the good and bad cable conductors to the Wheatstone Bridge in making the Varley 1 measurement for locating a ground, short circuit, or cross, is the same. The bridge connections for the Varley 2 and Varley 3 measurements, depend on the nature of the fault.

Fig. 1, shows the bridge and cable terminal connections for locating a ground; *Fig. 2*, a short circuit, and *Fig. 3*, a cross. The only difference in the set-up for the three measurements is the point to which the bridge battery is connected. For example, in the Varley 1 measurement, shown in *Fig. 1*, with the bridge cam lever switch operated to the "VAR" position, battery is connected to the bridge "GR" binding post, then through (RG) the ring side of the good pair, to the strap "S" at the cable terminal.

In the Varley 2 measurement, the good pair (RG) ring conductor is disconnected from the bridge "GR" binding post and the battery grounded by connecting a local ground to the "GR" post. In the Varley 3 measurement, the ground is removed from the "GR" post. The battery is then connected to the faulty conductor of the bad pair.

Following are the steps in the method of making a ground test *(Fig. 1)*.

(1) The bad cable pair is cleared of all drop wires or other connections not part of the cable system.

(2) At the first cable terminal past the cable section in which the fault is known to exist, the good and bad conductors are strapped (connected) together. In this respect, it is important that a minimum of resistance be introduced in the circuits at this point to avoid an error in computing the location of the fault. The strap wire is placed around the good and bad conductor binding posts at the cable terminal and tightly fastened.

(3) At the testing point, the tip (TG) of the good pair is connected to the bridge "X1" binding post, the ring (RG) to the bridge "GR" post and the ring (RB) of the bad pair is connected to the bridge "X2" post.

(4) The cam lever switch is oper-

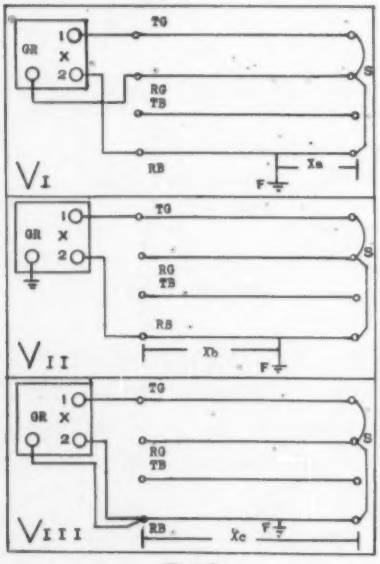

Fig. 1

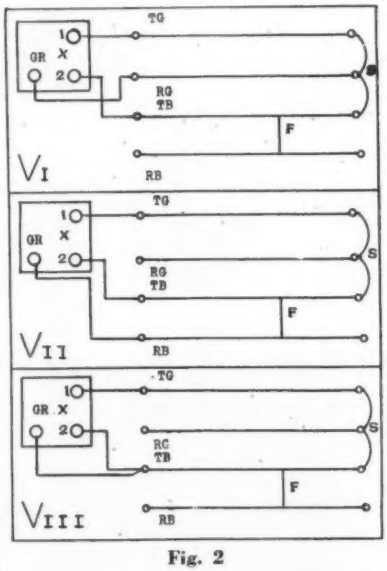

Fig. 2

ated to the "VAR" position and must remain in this position for all three measurements.

(5) The ratio dial is set at 1/9 which makes it possible to read the three Varley measurements to a fraction of an ohm, hence, greater accuracy is assured because in using the 1/9 ratio, the fraction is equal to $\frac{A}{A+B} = \frac{1}{1+9} = \frac{1}{10}$ or 0.1, thus simplifying computing the measurement values.

(6) The rheostat dials are rotated in the order of their respective values, and the galvanometer shunt keys are alternately depressed and released in sequence until the galvanometer needle rests at zero. The rheostat reading is called R1.

(7) The good pair ring conductor is removed from the bridge "GR" binding post, and the "GR" post connected to ground as shown in *Fig. 1*, (Varley 2).

(8) The bridge is balanced as outlined in Item 6, and the rheostat reading is called R2.

(9) The ground is removed from the "GR" post, and a lead from the bad conductor (RB) is connected to the "GR" post.

(10) The bridge is again balanced as outlined in Item 6, and the rheostat reading is called R3.

Example: Suppose a ground exists in a 22-gauge cable 5,834 feet long. Three measurements V1, V2, and V3 are made, in which the first reading (R1) equals 769 ohms, the second (R2) equals 1,084 ohms, and the third (R3) equals 1,710 ohms.

The resistance in ohms to the fault from the strap "S" at the cable terminal, resistance to the fault from the testing point, and the total resistance of the bad conductor, respectively, may be computed by means of the following formula, where Xa = (R2 — R1) × .1, or 1,084 — 769 = 315 × .1 = 31.5 ohms, and is the resistance to the fault from the strap at the cable terminal.

Xb = (R3 — R2) × .1 or, 1,710 — 1,084 = 626 × .1 = 62.6 ohms, and is the resistance to the fault from the testing point.

Xc = (R3 — R1) × .1 or 1,710 — 769 = 941 × .1 = 94.1 ohms and is the total resistance of the bad conductor. *Fig. 4* shows a modified arrangement for making the computation.

The three readings R1, R2, and R3 are entered in their respective spaces, the necessary subtractions are made and the result pointed off to one decimal place.

A double check of the correctness

(Continued on page 44)

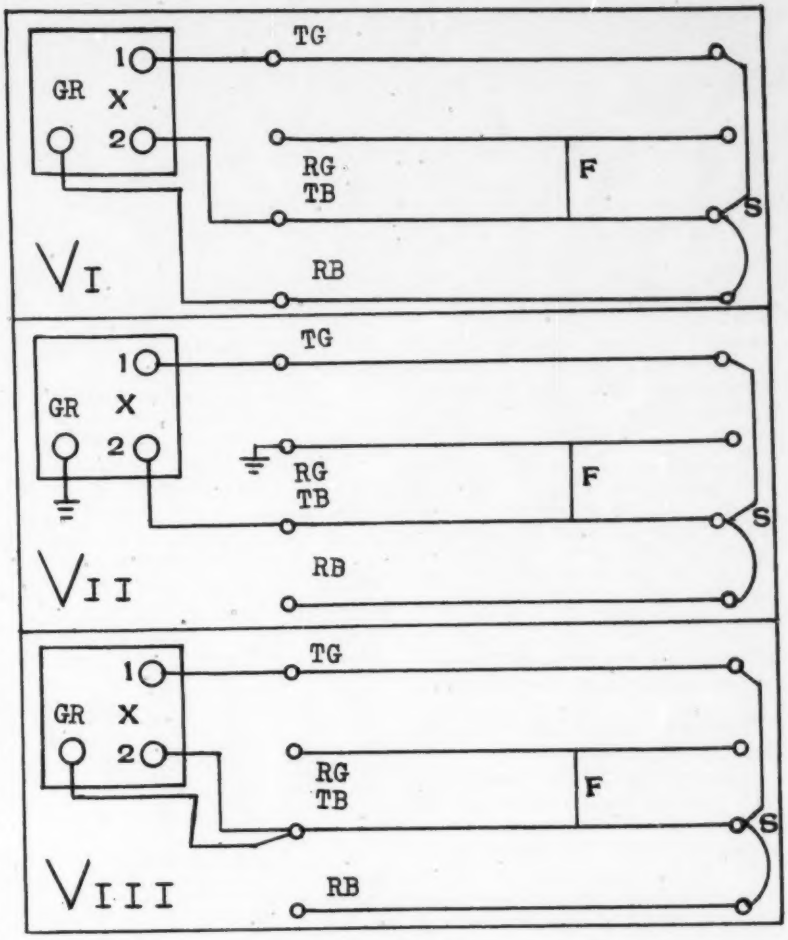

Fig. 3

THREE VARLEY READINGS		
R2 1084	R3 1710	R3 1710
R1 769	R2 1084	R1 769
Xa 31.5	Xb 62.6	Xc 94.1

Fig. 4

California Company Converts Tower into Christmas Tree

A BLAZE of color announced the holiday season for the California Interstate Telephone Co., Victorville. The company turned a microwave tower into a giant Christmas tree decorated with hundreds of colorful bulbs. The tower is located immediately behind the company's local offices in Victorville. It can be seen for miles in all directions when lit. Company officials believe that this is the first Christmas tree of this type in the nation.

The tower stands approximately 150 feet high. Decorating it are eight strings of various colored lights extending from immediately below the reflector screens to the ground. The strings are fanned out and away from the tower evenly spaced to give the appearance of a giant Christmas tree.

The installation, which was completed by a local electrical contractor, has 400 different colored bulbs.

In publicizing the event, Lyal Martin, Victorville exchange manager, said, "We have installed these lights as a community program. We of the Interstate Telephone Co. feel that this type of decoration for the holiday season will attract considerable attention to the Victor Valley area."

The tower is a repeater station for the company's microwave system extending in California from Bishop to San Bernardino where the circuits are connected with connecting companies.

The tower will also serve as a terminal for a recently installed microwave link between the company's new Wrightwood exchange and the Victorville long distance center.

Lights were furnished by Graybar Electric Co. According to a California Interstate company spokesman, "When Bud Kelly, Graybar's salesman, was apprised of the program, he very cooperatively pulled out all stoppers and secured the necessary equipment on an emergency basis. Without this cooperation . . . it is questionable whether or not the lighting would have been available in time for the picture shown on the cover."

The total cost of the installation to the company (including lights and installation) was approximately $750. Company spokesmen said they feel it was well worth the cost involved from the public relations standpoint as indicated by many letters received. Letters came from service clubs, other companies in the area, the Junior Women's Club, local banks, etc.

Pictures were shown in many of the local papers and publicity, as a result, was widely distributed and favorably received by these newspapers in the company's area.

Similar lighting is also being provided by California Interstate for the northern terminal of this microwave system at Bishop.

"World's Telephones" Report For 1959 Issued by AT&T

There are more telephones in the United States than in the rest of the world combined.

The "average" American uses his telephone 472 times a year.

If he wants, he can call such exotic places as the Fiji Islands (about 60 people did last year, by the way), Surinam, Antigua or just about any place on earth.

These are some of the highlights of the 1959 issue of *"The World's Telephones,"* released recently by American Telephone & Telegraph Co.

The report shows that the U. S., with 66,645,000 telephones at the start of this year, accounted for more than 50 per cent of the world's total of 125 million.

There are nearly 71 million telephones in the U. S. now, AT&T says, but it takes nearly a year to obtain data for the publication, so all figures relate to the start of 1959.

The United Kingdom, with 7,525,000 sets, ran second to the U. S. in total telephones. Canada was third with 5,123,000, followed closely by the German Federal Republic (West Germany) with 5,090,000. Russia has an estimated 3.7 million telephones.

Alaska and Hawaii, states now, but still separate territories at the time the report was being compiled, are the two "talkingest" places in the world, according to the report. Alaska averaged 609 telephone conversations per person in 1958 and Hawaii, 536. Next came Canada with 511, the U. S. with 472 and Sweden with 346.

Other *World's Telephones* highlights:

—American telephone users now can call 130 other countries or areas and can be connected with nearly 98 per cent of all the telephones in the world.

—There are 38 telephones in the U.S. for every 100 persons. Four is the average for the world as a whole. Sweden has 34 per 100, Canada 30, Switzerland and New Zealand 28 each, and Australia 20.

—Among cities, Washington, D. C. ranks first in telephone density, with 71 telephones per 100 population.

—New York tops the list of cities—and most countries—in total telephones, with 4,289,060. Besides the U. S., only four nations — The United Kingdom, Canada, West Germany and Japan — have more.

No busy signals are in evidence in the Aden Protectorate, Bhutan, the Comoro Islands, the Maldive Islands, Trucial Oman, Yemen, Nauru, Pitcairn Island or the Tokelau Islands. That's because there are no telephones at all in these places.

Name S.D. Company Manager

Darwin Knight, plant superintendent of the Deuel Telephone Cooperative Association, Clear Lake, S. D., has been named manager of the company. He succeeds Newman Jacobson. Mr. Knight has been with the company since 1954, serving, for the past two years, as plant superintendent.

Conn. Inn Offers Telephones In Every Bathroom

Stonehenge, country inn in Ridgefield, recently announced a "first" in Connecticut—a telephone in every bathroom.

With the completion of installation by Southern New England Telephone Co, technicians, Skinker Victor Gilbert's lodge now offers its guests the convenience of bathroom telephones in addition to having telephones in their bedrooms. (EDITOR'S NOTE: The *Merriam-Webster Unabridged Dictionary* defines "skinker" as "one who serves liquor, a tapster." TELEPHONY assumes that the modern interpretation of the word is "host.") All the instruments are in color, compatible with the room interiors.

Bathroom telephone communication in a hotel or motel is without precedent in the Southern New England company's area, which includes all of Connecticut.

The introduction of the feature at Stonehenge has long been planned by Mr. Gilbert, who is also president of the Connecticut Hotel Association.

In addition to the installations in the bedrooms and bathrooms, telephones are now available to all Stonehenge dining guests at every table in the Druid Bar, Parlour and Willard Rooms, Mr. Gilbert said.

The new Stonehenge switchboard will be located in a specially-designed area off the inn's reception room.

EDITOR'S NOTE: Until a successor to the late Harold B. McKay, TELEPHONY's Electronics Editor, who conducted this column for the past three years, is named, we will present articles and reprints of articles which deal with the application of electronics in telephony. Following is an article, reprinted from *The Engineer*, published by Western Electric Co., entitled "A History of Transmission Systems." The author of the article is Robert B. Stecker, superintendent, Systems Engineering-East for the Defense Projects Division of Western Electric Co.

A HISTORY OF TRANSMISSION SYSTEMS

In our era of constant technological upheaval, it is easy to become so enmeshed in the problems of the moment that we lose perspective. Here the 83-year history of telephony is retold in terms of two interrelated trends: (1) The spectacular conquest of distance, and (2) the challenging struggle against excessive costs.

by ROBERT B. STECKER

THE ASTONISHING evolution of electrical communications since Alexander Graham Bell invented the telephone is not so widely known as the story of man's conquest of the air or his exploits in the field of nuclear physics. It is none the less a record of technical achievement rivaling either of these in interest and importance.

Primitive man communicated with his fellows over long distances, using drums or smoke signals. And the telegraph was a modern extension of these arts. But it was the development of telephony which permitted man to project his personality and feelings, through the characteristic tone and inflections of his voice, to the ends of the earth.

We can hear the voices of others because in talking they set up sound waves which travel through the air, strike our eardrums and are registered on our auditory nerves. The frequency of the sound waves determines the pitch we hear, with low frequencies corresponding to low pitch and high frequencies to high pitch.

Fig. 1 shows the entire range of frequencies that produce audible sounds. Most of us have a somewhat smaller hearing-response range and our ability to detect very high pitched sounds decreases markedly as we grow older. The chart shows why high-fidelity recording systems should be equally effective or "flat" over a wide band of frequencies to permit faithful reproduction of all the various musical instruments.

Telephone circuits, however, need not transmit such a wide band of frequencies to reproduce the human voice faithfully; and it is interesting to note that where quality of reproduction and the ability to recognize the talker are not important, intelligible speech can be transmitted using a band of frequencies only about 1,500 cycles wide.

The transmission of speech over electrical circuits requires that sound waves be converted into electrical signals. The first device capable of making this conversion was Alexander Graham Bell's telephone, pat-

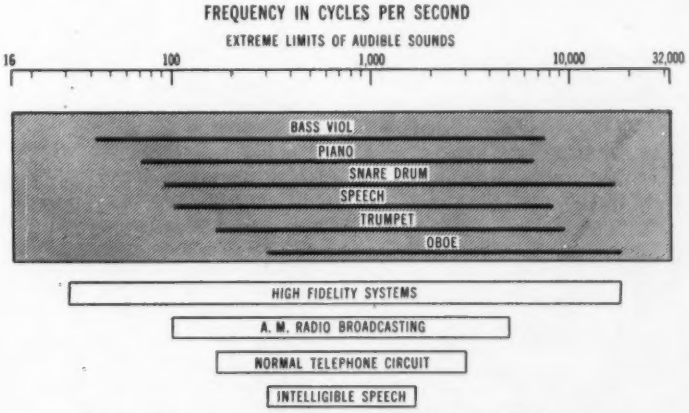

Fig. 1. The range of frequencies producing audible sounds.

ented on Mar. 7, 1876. *Fig. 2* illustrates the early types of equipment used by Dr. Bell.

In the 80-odd years since the invention of the telephone, the basic principles have remained almost unchanged. The only significant difference in today's telephone instrument is that the clumsy liquid pool transmitter has been replaced with a closed container of dry granulated carbon particles. Its resistance changes with changes in pressure caused by sound waves.

Bell's first words travelled only the short distance between rooms in a house. Experiments soon followed, however, using even longer distances.

Quite naturally, the first experiments used telegraph lines. Morse had invented the telegraph more than 30 years earlier, and many miles of telegraph lines had already been constructed. Early telegraph lines used iron or steel wires and often followed railroads between cities.

The first transmission of speech over a distance of several miles took place only a few months after the telephone was invented and by November 1876 Dr. Bell was able to demonstrate successful two-way telephone conversation over the 16-mile telegraph line of the Eastern Railroad between Boston and Salem, Mass.

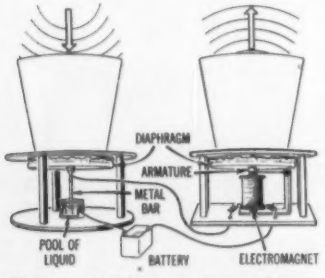

Fig. 2. Bell's experimental telephones. Membrane telephone, right, was his first transmitter, but later was used as a receiver. Liquid pool transmitter, left, transmitted first message.

Significantly, a Sunday was chosen for the demonstration in order that interference from the railroad telegraph circuits would not cause interruptions. This interference was due largely to Bell's use of ground-return circuits, then standard for telegraph. A ground-return circuit uses only one wire, with the earth or ground serving as the return path for current.

When several ground-return circuits operate on the same line, the joint or shared use of the ground-return path results in strong interference between the circuits. This had not been too troublesome in telegraph work, but the highly sensitive telephone receiver was overwhelmed with clicks and thumps from neighboring telegraph circuits, and conversation was all but impossible except at times such as a Sunday when the telegraph circuits were silent. The metallic circuit, with a second wire in place of the ground-return path, was first used in 1881. This was a major advance and now seems so obvious that it is difficult to see why the ground was ever used.

Hard drawn copper wire, more efficient than iron and steel, was first used on a large scale in 1884 and made transmission over greater distances possible. Interference, however, was still troublesome even with metallic circuits.

The interaction between circuits was finally solved with the development of transposition plans which periodically rearranged the position of the wires of a line relative to one another. This insured that the individual circuits did not parallel each other for long distances, thus reducing the coupling between them and the resulting interference.

The 1890's saw rapid expansion of long distance telephony. Service was opened between New York and Chicago in 1892; and soon thereafter connections were made to the other major midwestern cities—Cleveland, Detroit, Dayton, Cincinnati and Indianapolis. By the turn of the century, more than 17 million dollars had been invested in long distance telephone lines.

Loading

The year 1900 saw the first commercial use of a most ingenious invention, which greatly increased the efficiency of telephone circuits. It quickly rolled back distance frontiers and made possible the connection into the rapidly growing telephone network of cities halfway across the country and others as far south as New Orleans.

This invention was the technique called loading. Patented on June 19, 1900 by Prof. M. I. Pupin of Columbia University, it involved the insertion of inductance coils at frequent intervals along a telephone circuit. Similar studies had been made by George A. Campbell who directed the first application of the loading principle to a cable in Boston in 1900. The resulting increase in efficiency is quite remarkable as shown in *Fig. 3*. It is interesting to note that while a non-loaded circuit exhibits gradually poorer transmission as the frequency is increased the efficiency of a loaded circuit remains excellent over a wide frequency range and then deteriorates abruptly.

The cut-off frequency depends on the size and spacing of the coils. The

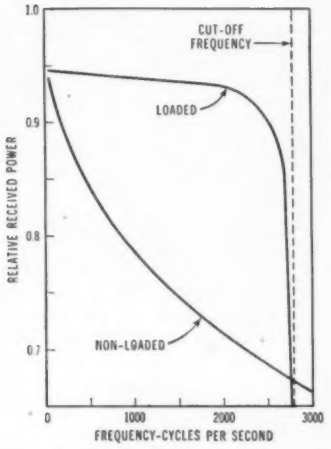

Fig. 3. Efficiency of loaded and non-loaded telephone circuits.

first loaded circuits had a cut-off frequency of about 2,300 cycles per second. (Today, using smaller, more closely spaced coils, circuits can be established with cut-off frequencies above 11,000 cycles per second.)

In addition to making it possible to talk farther on open wire lines, loading made what was destined to be its more important contribution in the then infant field of telephone cables.

By the early 1880's, the growing forest of poles and overhead wires had become a matter of grave concern, not only to telephone men, but to the public as well. The West Street line in New York used poles as high as a nine-story building with 30 crossarms to carry its 300 wires; and in Boston, there were 2,000 wires attached to the rooftop structure of the telephone company's Pearl Street office.

In addition to causing unsightly congestion, overhead wires were vulnerable in storms. Sleet storms were especially devastating, flattening lines for miles in many parts of the country each year. The obvious answer was to put the telephone circuits underground. This task was pursued with all possible speed amid a rising public clamor against the overhead wires. Laws were enacted requiring that all wires be placed underground. In New York, not satisfied with telephone company progress, Mayor Grant actually sent men out with axes to chop the poles down.

One of the biggest obstacles was the staggering loss suffered by speech currents in traversing even a few thousand feet of the early underground cable. This was due not only to the small size of the wires but also the undesirable effects of the rubber or gutta percha used for insulation.

The introduction of cotton and then paper insulation together with a process for extruding a lead covering or sheath directly over the wires to seal the cable against moisture took several years of patient step-by-step development.

These improvements made it possible to make telephone cables several miles long. These were suitable for replacing the overhead wires in built-up city areas, although cable losses were still too high for long distance work.

As with the open wire, however, loading greatly improved cable efficiency and made possible, in August 1902, the first long distance underground cable circuits connecting New York and Newark, N. J., a distance of about 10 miles.

Cables were placed between Boston and Worcester in 1904 and from New York to Philadelphia and New Haven by 1906. Many thousands of miles of loaded cable circuits are in use today, furnishing good quality local and long distance telephone service.

Loaded cable and open wire circuits were the final achievements of an era that lasted almost 30 years. During this time, various ways had been found to increase circuit efficiency and send speech currents over longer and longer distances before they died out. It was finally possible for the feeble electrical currents produced by a telephone transmitter to travel the remarkable distance of more than 1,000 miles, unaided, and operate a receiver at the distant end.

Repeaters

Practical efficiency limits had been reached, however, and a technical breakthrough was needed for speech distances to be extended. There were two obvious approaches: Make speech currents stronger initially or rejuvenate them enroute.

The search for a powerful, loud-speaking type of telephone transmitter for generating stronger initial currents was pursued at some length, primarily by experimenters in Europe. This approach proved ineffective, however, and was finally abandoned.

In this country, Bell System engineers favored the idea of speech rejuvenation and concentrated their efforts on perfecting apparatus which would be capable of receiving the attenuated currents after transmission over a few hundred miles of line and delivering to the adjacent section of line greatly amplified currents of the same wave shape.

Various devices were constructed and some experimenters were able to demonstrate circuits which produced increased loudness in the telephone receiver. In all cases, however, the increased loudness was accompanied by so much distortion that the re-

ceived speech sounds were unintelligible.

On July 8, 1904, Herbert E. Shreeve, of the American Telephone & Telegraph Co., applied for a patent on a device which he called a Telephone Current Reinforcer or Relay. This device, later known as the Shreeve Repeater, was the first successful amplifier of telephone currents. It consisted essentially of a telephone receiver and transmitter coupled together mechanically and has been aptly described as the telephone that shouts in its own ear.

Fig. 4 shows how the Shreeve

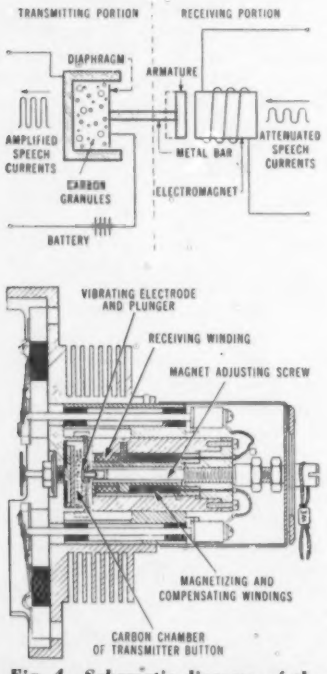

Fig. 4. Schematic diagram of the Shreeve Repeater (top) and cross section of the 3A repeater, which became the standard type (bottom).

Repeater worked. Attenuated speech currents entering from the right caused the electromagnet to exert varying amounts of pull on the armature. Movement of the armature produced corresponding movement of the mechanically coupled diaphragm. This, in turn, caused the carbon granules to be more tightly or loosely packed, with resulting changes in resistance. The changing resistance of the cup of carbon granules controlled the flow of current from the battery and produced amplified speech currents of roughly the same wave shape as the ones originally received.

A repeater was first used commercially on a circuit between New York and Chicago in August 1904. Transmission was significantly improved and more repeaters were quickly placed in service in the several years following.

The Shreeve Repeater had serious disadvantages, however. It was relatively unstable. This restricted its use to non-loaded circuits and to a maximum of one repeater per circuit. Also, its amplification varied with the loudness of the incoming signal. Thus, the weakest signals, which most needed rejuvenation, were only slightly amplified while the stronger ones received progressively greater amplification.

In 1909, Theodore N. Vail, president of AT&T, promised telephone service between New York and San Francisco to the management of the Panama-Pacific Exposition in time for their planned opening in 1914. A stable, more powerful repeater was needed for coast-to-coast service and efforts to find such a repeater were intensified.

This work produced, in 1912, a greatly improved version of the Shreeve Repeater which was sufficiently stable to be used on loaded circuits. Also, several of the new repeaters could be used in tandem on a long circuit. This repeater was widely used for almost a decade, with many units still in service as late as 1920.

The real breakthrough came, however, with the advent of the vacuum tube repeater in 1913.

Lee DeForest had invented the Audion some seven years earlier. This was a vacuum tube having three elements: A filament which, when heated, gave off electrons; a plate, to which the electrons flowed; and a grid, which acted as a valve to control the electron flow. H. D. Arnold was able to overcome the weaknesses of the Audion, principally by improving the vacuum; and thus it was not until 1912 that a true amplifier using the device was demonstrated.

The essentials of vacuum tube amplification are shown in *Fig. 5*. The small battery, "A", serves merely to heat the filament, causing it to give off electrons. The plate is given a positive (+) charge by battery "B", causing it to attract the negatively charged electrons. Electrons flow from the filament to the plate, passing freely through the grid which

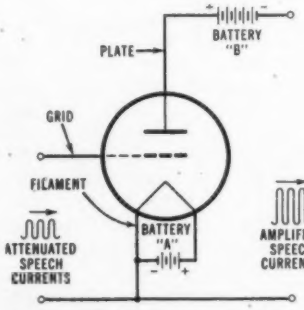

Fig. 5. Schematic diagram of vacuum tube amplification.

is made of very porous mesh. However, positive or negative charges on the grid act to help or hinder the flow of electrons, acting in much the same way as a valve. Thus, as the attenuated signal currents vary the charge on the grid, the current through the tube varies accordingly and amplified currents of about the same shape as the original signal are produced in the output circuit.

The first vacuum tube repeater was installed at Philadelphia on the New York-Baltimore line in October 1913. Refinements came swiftly and by mid-summer of the following year, the first tests were made on transcontinental circuits using six repeaters in tandem. Commercial service between New York and San Francisco was begun on Jan. 25, 1915, easily fulfilling Vail's earlier promise to the Panama-Pacific Exposition which was delayed and opened later that year.

Thus, in the short span of 40 years, the art of speech transmission had progressed from Alexander Graham Bell's first crude apparatus to circuits capable of covering virtually unlimited distances. By the time of Bell's death on Aug. 2, 1922 the telephone had spanned oceans using radio, and had been used to talk successfully with ships at sea and airplanes in flight.

Multiplex Telephony

While the conquest of distance produced more effective circuits capable of carrying the human voice over greater and greater distances, it also inevitably led to higher and higher costs. Two-wire metallic circuits had replaced the early single wire ground-return circuits; copper wire took the place of cheaper iron; transposition schemes and loading techniques were introduced; and finally, shortly after the turn of the century, repeaters were invented and became a part of long-haul circuits. All of these developments meant greater capital expenses.

In the face of increased circuit costs, telephone engineers applied themselves to the problem of making better use of each circuit. Where a pair of wires had historically carried only a single conversation, they now sought means of increasing this to two or three or even more simultaneous conversations.

The phantom, first used in 1902, was an important step. It derived three circuits instead of the customary two from two pairs of wires. The required equipment was minor and effectively three circuits could

(Continued on page 38)

how to get FCC licenses for your technicians

(without sending them to school)

The greatly increased use of mobile communications and microwave relay systems by the telephone industry is creating a serious problem . . . how to get FCC licensed technicians.

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Direct line municipal fire and

a new telephone alarm system by Automatic Electric

Dramatically direct emergency reporting! Any number of strategically located street boxes provide direct telephone communications. Direct from the public to Fire headquarters. Or, from the patrolman on the beat to Fire or Police headquarters.

Now the general public has instant voice contact with Fire Department headquarters—simply by picking up a telephone handset located in the weatherproof street box.

Each call is instantly recorded on an automatic typewriter which types out the street box number, the time and the date a call is made. The conversation may also be voice-recorded on tape and stored for future reference.

Open lines or acts of vandalism to the instrument or the telephone cord are reported automatically to headquarters.

The Fire and Police Department switchboards which receive calls from the street boxes are arranged so as to provide interconnection with other telephone facilities.

TO REPORT A FIRE

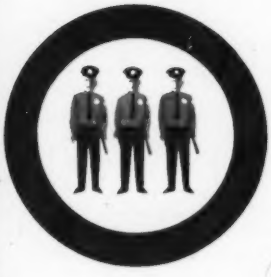
The passerby opens the street box, picks up the handset and talks directly to the Fire Department operator.

TO CALL THE POLICE

Authorized police and city personnel get direct connection to the Police Department switchboard console by pressing a recessed button and picking up the handset.

police reporting

The trained operator at the Fire headquarters switchboard can request details before notifying the appropriate station. A call locks into the switchboard—a light and audible signal continue even after the street box telephone is hung up.



The operator at the Police Department switchboard can transfer the call to a specific section of the department, or he can obtain all the information necessary and then relay it to the appropriate division.

FOR MORE INFORMATION WRITE THE VICE PRESIDENT, COMMUNICATIONS PRODUCTS SALES, AUTOMATIC ELECTRIC SALES CORPORATION, NORTHLAKE, ILLINOIS.

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Courts and Commissions

N. J. Commission Upholds Bell Attrition Allowance

The New Jersey Board of Public Utility Commissioners on Dec. 7 upheld its inclusion of 25.5 million dollars as an adjustment for inflation in a rate base allowed for New Jersey Bell Telephone Co. (TELEPHONY, June 13).

The case, involving an increase in annual operating income of $5,657,800 had been remanded back to the commission in June by the New Jersey Supreme Court.

An appeal of the commission's initial Dec. 1957 ruling had been taken to the court by the state's attorney general who had asked that the rate base should be restricted to its valuation in 1957 which was estimated at $502,041,000.

The state maintained that the rate base granted by the commission was erroneous because it included capital that was not in use.

The supreme court's ruling said that a rate increase should compensate a utility for inflation and for attrition of its assets.

It also said, "the board is not girded in its determination with an iron-bound formula which must be automatically applied in each instance."

However, the court questioned whether enough evidence was available on these two points (inflation and attrition) to justify the increase.

The board of commissioners determined that the fair value of the company's property at Dec. 31, 1957, based on net investment (net original cost) of plant, plus an allowance for cash working capital, materials and supplies, and property held for future use, amounted to $502,041,000. To this, the board added the 25.5 million dollars resulting in a total rate base of $527,541,000.

In its current ruling the board said:

"Inflation has had the economic effect of reducing the purchasing power of the dollar substantially from pre-World War II levels.

"In particular, on the basis of the record in this case, the board finds that inflation has had such an impact on this company, that net investment stated in terms of original cost does not fully reflect the fair value of the company's property used in the public service.

"The use by the board of the 25.5-million-dollar rate base adjustment was to provide an allowance for inflation. . . .

"As the court noted, the company offered evidence . . . to show that the excess investment per added telephone instrument during the 1957 test year, over what the same number of telephone instruments gained would have cost in increased investment if they could have been added at the same rate of investment per telephone existing in the preceding year, was 24.7 million dollars. This testimony was given on the basis of operating statistics for seven months actual and five months estimated for the year 1957. . . . At the time the board made its decision dated Dec. 30, 1957, the report for December 1957 was not yet on file. (Other months reports had been made a part of the record.)

"Therefore, the figure for excess investment for the year 1957, determined as of Dec. 30, 1957, necessarily had to be an estimate. (The figure) 25.5 million dollars constituted a reasonable estimate, falling between the limits of 24.7 million dollars which the company . . . had estimated and the actual figure of $27,752,000 which the later statistics showed. . . .

"This procedure reasonably measures the effect of inflation in this case and agrees in principle with methods followed in other jurisdictions and cited by the court.

"The board, however, did not rely solely on the testimony of the company . . . giving a dollar amount to the excess investment. It considered the evidence that the benefits of mechanization have already been largely realized.

"The board inferred from this that the excess investment occurring during the test period was not due to a more intensive investment in plant, to using more equipment per telephone instrument, but rather to an increase in the cost of the same quantitative amount of plant per telephone instrument used in rendering the public service.

"The allowance . . . is about 5 per cent of the net investment as of Dec. 31, 1957. The company had offered evidence . . . that the current value of its property devoted to the public service is 28 per cent above the average 1957 test period net plant investment. This was based on a trended original cost survey. . . .

"The board concluded that, taken by itself, such a study does not give a reliable measure of the value of the company's property.

"However, it is an indication that inflationary factors are having a serious effect on the company's property, confirming the board's decision to include 25.5 million dollars as a reasonable allowance for the effects of inflation.

". . . the adjustment (is) . . . an exercise of the discretion delegated to (the board) by the legislature which was based on relevant underlying factors.

"As the court pointed out in its opinion, the board may 'exercise reasonable expert judgment based upon all of the relevant factors.'"

On the same day, the board in a separate action approved extended calling areas in 60 of the New Jersey Bell company's 200 exchanges, benefitting an estimated 651,541 subscribers and resulting in an estimated annual decrease in gross revenues of $1,638,000.

Rules Company May Pass on Municipal Tax in Nebraska

The Nebraska Railway Commission on Nov. 30 dismissed a complaint of the city of Scottsbluff against the United Telephone Co. of the West. Scottsbluff had claimed that the company had no right to increase local telephone charges 80 cents per month to offset an occupation tax imposed by the city. The city further claimed that such an increase could not be made without a public hearing (TELEPHONY, Oct. 10).

The commission affirmed its order of Jan. 26, 1959 in which it stated: "When a city or village imposes upon the telephone company an occupation tax, license tax, permit or franchise fee, such tax or fee shall be billed pro rata to the exchange customers receiving service within the territorial limits of such municipal corporation."

The commission's order of Nov. 30 made these points:

"The enactment of any occupation tax assessed by any city or village against any telephone company, affects and reduces the rates of return authorized and ordered by this commission for said company.

"The enactment by city of said occupation tax constitutes the taking of property without due process of law and the taking of private property for a public purpose in violation of the

Constitution of the United States and the constitution of the state of Nebraska.

"The city is not authorized to appear before this commission on behalf of subscribers to and users of telephone service.

"That in the absence of constitutional or statutory requirements or rules of this commission, a telephone company is not required to give notice to anyone, or to obtain consent for making any change in its rates or in its rules and regulations.

"Complainant takes the position that such tax expenses should be included by the company in its overall expenses and in turn should be charged against all rate-payers in its system.

"This commission is of the opinion that such method of charging the tax is unfair to the rate-payer residing outside of the cities imposing such taxes, and it would encourage all cities served by the company to levy as high an occupation tax as possible and require rate-payers who are not residents of the particular city to pay the taxes for the upkeep of such city.

"Any method of treatment of occupation taxes of any city or village that fails to pass on an occupation tax pro rata to the subscribers in the city in which it is levied, inevitably creates a situation prejudicial and unjustly discriminatory in respect to subscribers in areas in which no such taxes are levied.

"It would be manifestly unfair to impose upon the many thousands of telephone subscribers of the company who live elsewhere than in the city of Scottsbluff the burden of providing the dollars necessary to pay the occupation taxes to the city. (It is no answer to say that the company itself should pay this tax, for the company must necessarily pay it out of dollars received from its subscribers.)"

The commission summed up its finding in these words:

"There are two reasons why it is reasonable and just to require the company to add the local taxes to the charges for local service rather than to the charges throughout its system:

"(1) The taxes paid to the city by the company are used by the city for the benefit primarily of the people who live there. If the company did not pay these taxes, the city would have to levy other taxes, and these other taxes would be paid by the local citizens.

"(2) If a locality can levy taxes that are paid mostly by people who do not live and vote there, self-interest will persuade it to rely more and more on such taxes for the support of local government."

OK Billing of Franchise Tax to Subscribers in Ark.

Allied Telephone Co., Little Rock, on Dec. 9 received permission from the Arkansas Public Service Commission to pass on a franchise tax increase at Sheridan to subscribers (TELEPHONY, Oct. 17, 1959).

The Sheridan City Council in June increased the company's franchise tax by $300 annually. The company serves 605 subscribers in Sheridan.

Ask Regulatory Aid in Ohio In Toll Settlement Case

General Telephone Co. of Ohio, Marion, is reported to have been unable to reach an accord with Ohio Bell Telephone Co. on toll settlements and separations procedures. General of Ohio on Dec. 16 filed a complaint with the Ohio Public Utilities Commission challenging the reasonableness of the existing basis of settlements on interchanged toll business.

The complaint, among other things, draws attention to the fact that the 1959 USITA Separations Manual was issued in October setting forth standard separations methods and procedures, consistent with the fundamental principles set forth in the 1957 NARUC-FCC Separations Manual, and requests approval of use of these methods and procedures for studies to determine General's cost of furnishing message toll telephone service jointly with Ohio Bell.

This is reported to be the first instance in recent years of a formal complaint by an Independent company seeking regulatory aid in the establishment of what it considers to be fair and equitable settlement arrangements with a connecting Bell company.

Files Suit Against Municipal Tax in Illinois

Leslie J. Smith, an attorney, has filed a petition in Illinois Circuit Court asking for a restraining order against the village of Forest Park to prohibit collection of a municipal utility tax.

The village imposed the tax effective Nov. 1. The tax is billed by the utilities.

Mr. Smith has asked the court to nullify the emergency clause of the tax raising ordinance and restrain the utilities from collecting the tax until a forthcoming election. He asks that part of the money already collected under the ordinance be used to pay for his law suit and the remainder be returned to persons assessed.

Asks N. D. Purchase OK; 2nd Sale Approved in S. D.

The West River Mutual Aid Telephone Corp., Hazen, has asked the North Dakota Public Service Commission for permission to buy the Fort Yates exchange from the Department of Interior it was reported on Dec. 3. The Standing Rock Indian Agency formerly served the exchange.

In another action, the West River company received authority from the South Dakota Public Utilities Commission to purchase the McLaughlin exchange from Frank Dixon.

Rates when dial service is installed will be as follows:

One-party business	$7.75
Two-party business	6.50
One-party residence	5.00
Four-party residence	3.00

N. J. Woman Fined $200 for Refusal to Yield Line

In Millburn, N. J., police magistrate Milton Freiman on Dec. 18 fined Mrs. Mary C. Zelinski $200 on a charge of violating the disorderly persons act by refusing to yield the telephone line to a doctor who wished to call an ambulance for an 81-year old heart patient (TELEPHONY, Nov. 28).

Dr. Marvin Becker testified that when he tried to call the ambulance, and asked that two women yield the line, one of them told him to "go to hell," and despite his repeated requests, they scoffed at him. The daughter of Mrs. Sophie Wetzel, the patient, went to a neighbor's home and telephoned.

Magistrate Freiman suspended Mrs. Zelinski's sentence, pending an appeal. In her testimony, Mrs. Zelinski said that she was on the telephone only about 10 seconds after the doctor's request, when her husband grabbed the receiver and hung it up. She could have received a $1,000 fine and a year in prison.

In the case of Mrs. Jeanette Hausler, the other woman in the refusal, Freiman withheld a verdict, pending study of a motion challenging his jurisdiction.

Sale of Kansas Company Complete; Cut-Over Planned

The sale of the Border Telephone Co., Syracuse, Kan., to the Pioneer Telephone Association, Inc., Ulysses, Kan., was reported completed during the first week of December (TELEPHONY, Oct. 10).

The Kansas Corporation Commission, it was reported, earlier approved the sale to the Pioneer association, which plans to convert to a dial system.

Ray Jackson, former owner of the Border company, will remain with the new owners as manager of the Syracuse system until the cut-over is completed.

Asks to Sell in Ind.

The Freeman Telephone Co., it was reported on Dec. 8, asked the Indiana Public Service Commission for permission to sell to the Smithville Telephone Co. of Ellettsville. Freeman has a manually-operated exchange, but would get dial service, and also extended area connections, under the terms of sale.

THE Plant Man's Notebook

BY RAY BLAIN, TECHNICAL EDITORIAL DIRECTOR

THE MICHIGAN Bell Telephone Co. is now offering two types of telephone fire alarm systems to Michigan communities. One system is designed for small communities and the other for larger populated areas which are served by both regular fire departments and volunteers.

The new Volunteer Fire Reporting Service is designed to provide an efficient means of answering emergency calls made to the local fire department's telephone number. With this service, special red telephones are installed in the homes and business places of from two to 10 volunteer firemen. When anyone calls the fire department number, these telephones will ring simultaneously with a distinct tone.

The first volunteer to answer his telephone talks to the calling party and obtains the necessary details. Other volunteers also answer the call, but they can only listen in. The first volunteer to answer can start the community fire siren by signalling back over the telephone circuit. This service is expected to be particularly useful in small communities where it is impracticable to have someone continuously available to answer the fire department's telephone.

For larger communities which have both a regular fire department and volunteer firemen, a Group Alerting and Dispatching Service is now available. With this new system, a dispatcher can notify from 20 to 480 volunteers of a fire and its location without making the general public aware of the situation.

It is designed for use with all types of dial telephone offices and permits connecting from one to three control stations to as many as 480 telephones located in volunteer firemen's homes or business places. The dispatcher can also notify from one to seven groups of volunteers, individually or collectively.

When a caller reports a fire to the central fire department, the dispatcher located there decides what group of volunteer firemen needs to be alerted. He dials a one-digit code which connects him with all idle exchange telephones for that selected group. The dispatcher begins his message immediately after dialing and continues it until he disconnects or until he is automatically disconnected by a pre-set timing device. If necessary, he can re-establish the automatically broken connection by re-dialing and re-setting the timing device.

With this system, as with the other, firemen can only listen in. They can't talk with the dispatcher. Should any line be busy when the dispatcher dials, a special "camp-on" feature seizes the line and rings as soon as it becomes idle, provided the dispatcher's announcement is still being sent out. By using a recorder, the dispatcher can repeat the message automatically as long as he wishes.

When the system is being used by any one of the dispatchers, the other dispatchers are "locked-out" and furnished a busy signal. After the emergency message is received, the called telephones are disconnected from the system and are made available for normal use by simply hanging up the handsets. Although the most common use of these new services will be for fire departments, they also could be used for Civil Defense activities and other emergencies.

In our opinion, it is good for operating telephone companies to get into the fire reporting business. Certainly, they are best equipped to provide this worth-while service to any community.

•

While we were in Japan last year, we purchased a small transistorized radio receiver not much larger than a package of cigarettes. On the eastern shore of Maryland recently, this set picked up broadcasting stations in Baltimore and Washington, an air-line distance of nearly 200 miles.

This is certainly a far cry from the early days of radio broadcasting. We remember our first receiver equipped with a dozen or more controls, and a big outside antenna. It was powered by a large storage battery with a rectifier for charging. The entire outfit probably weighed over 400 pounds.

We listened to local broadcasts for the most part and on some nights that were good for reception, we occasionally picked up an out-of-town station. To hear a station from a distance of 200 miles was considered a real feat in those days.

•

Evidence of the close parallel between accidents and traffic violations is indicated in the latest analysis of highway accidents by the National Safety Council.

In last year's accidents, 55 of every 100 drivers were violating at least one traffic law. The most frequent violations were those of proceeding without having the right-of-way, and following too closely behind another car.

•

The writer flew from Washington, D. C., to Boston in an American Airlines "Electra" in one hour and eleven minutes recently. We spent two very pleasant days in Boston conferring with communicators and then returned on a Northeast Airlines "Viscount."

•

It costs $12 for the first three minutes, day or night, plus Federal Tax, and $4.00 for each additional minute, to talk to Paris over the new submarine cable. Including the land cables, this new cable is 4,400 miles in length.

•

When you take responsibility on your shoulders, there is not much room left for chips.

DO YOU THINK WE'LL EVER GET THERE?

WE'VE SURE COME A LONG WAY!

JANUS—the Roman god who looked both ways; the origin of our month of January, when we at Stromberg-Carlson look ahead at the year to come and at the same time review the months that have passed. It's also a major concern of Independent operating companies.

Looking ahead, in any business, is necessary. In the telephone operating business it is *particularly essential* because of the long-term-investment aspect; it takes more capital and more time to increase plant capacity than in most other businesses. Once this higher capacity for service is reached, the telephone company cannot economically reduce this service if demand slackens. Fortunately, there has of late been only one direction to the demand curve for service—upward.

Sometimes, at first glance, it's hard to see progress. That's when a backward look is good . . . a look that shows how far one has come. Jesse Bigelow, of the Ponderosa Telephone Company in O'Neals, California, is enjoying this backward look. His company, like so many others, has come a long way. Read his story, change a few names—it could be yours!

* * *

"Explosive" best describes the situation in O'Neals, as 1957 turned into '58. True, a telephone company lives on customers, but even food is better in digestible quantities. Too much of a good thing nearly had the small operation, then known as the Bigelow Telephone Company, swamped. And it all happened so suddenly.

Operators "boarded in"

Back in 1902 Jesse Bigelow's grandfather undertook to furnish telephone service for himself and other isolated ranchers in the valleys on the western slopes of the High Sierras. It was definitely a side-line convenience; no one could see much potential in an area that was well-nigh inaccessible. Whenever a new settler did move in, the system was stretched to include him—each added mile increasing the cost of operation while lowering the grade of service. In order to keep trained operators, a portion of the ranch house was converted to a dormitory, where room and board was furnished as an incentive to employment. Somehow the company got along, and the telephone franchise was passed down through the family along with the acreage.

Just a few years ago this quiet region erupted. Large lumber operations moved into the Ponderosa forests; a construction firm worked round the clock building a huge hydroelectric dam; the government established fish hatcheries; vacationists "discovered" Huntington Lake and other equally delightful resort locations. There was much talk of a direct highway connecting Yosemite with Sequoia National Park, bisecting the franchise area. The little squadron had become an army of occupation; telephone service that was a convenience for the few now was a necessity to the many. Could the existing Bigelow Telephone Company handle the job?

Help at the right time

"I have orders right now that would double my stations if I could give them service," Mr. Bigelow told a Stromberg-Carlson field engineer in 1956. And it didn't take this Credit Corp. man long to see that it was true. An independent auditor made a feasibility study, helped prepare a report to the state commission. Then the home office engineers went to work to prove, in a proposal, how the job

could be done. One Stromberg-Carlson recommendation saved thousands of dollars while improving service: to serve the area through four small dial offices instead of a single large exchange. In many other ways the Credit Corp. helped Mr. Bigelow make a pattern to fit his cloth. What had seemed like a lava flow channeled to entomb him and his company, now took on the Cinderella aspect of an oil gusher firmly capped.

That was 1958. 1959 was filled with feverish but purposeful activity. And today, as Jesse Bigelow reviews the hectic months that have passed, his son Robert, daughter Elizabeth and her husband Mr. R. L. Silkwood look forward to '60 and beyond. And what they can see from here looks good!

* * *

Drama — intense and daring — is packed in every line of a story that's unfolding right now in Oklahoma. No time for backward looks here; the present is too real . . . and too present! It began like a TV Western.

Twice a boom town

Earlsboro lay just 50 miles southeast of Oklahoma City, and what a boom town it was just after the turn of the century! Liquor — banned in the City during these pre-statehood days—was legal in Earlsboro. Twenty-six saloons crowded its two-block main street. Statehood and constitutional prohibition came to Oklahoma and Earlsboro in 1907, and the whiskey boom ended. But the telephone company—hastily organized in the lush days—hung on.

Then Earlsboro struck oil. The population zoomed from a few hundred to more than seven thousand. Paved streets were laid out in lots for miles around. A water system was installed, along with sewer and gas lines. The telephone company, not to be outdone, went metallic, with miles of bright new wire in place.

Suddenly the oil ran out, and the townspeople with it, just as the great depression of 1929 closed in. Earlsboro was left with a bonded indebtedness of $250,000 on the now unneeded water and sewer systems.

Thirty years have passed. A new boom is on in Earlsboro. Stromberg-Carlson and a man named Hines have a lot to do with it. Here's how they got together.

Is this a switchboard?

Early in 1957, John Hines, traveling computer salesman for IBM, stopped at the Pearson, Oklahoma, "exchange" to make a phone call. There was difficulty with the call, and John complained to the owner.

"Don't like our telephone service, huh! So why don't you buy this place?"

John Hines felt the sting of challenge in the woman's voice. Almost without thinking, he answered that challenge.

"I just might," he countered. "How much are you asking?"

In a matter of minutes, John Hines had bought the Pearson Telephone Company.

It wasn't long afterward that he began to wonder just what he'd done. The Pearson exchange was like the run-out oil wells. It consisted of 16 magneto stations and a 1906 model Stromberg-Carlson hang-on-the-wall switchboard that looked like a fugitive from the local museum. Could it be that what started as a hobby would turn into a monster?

Monster tamed

John grew quite fond of his "16 irate subscribers." (Anyone would have been irate with the kind of phone service they'd been getting.) Using the last of his cash reserves, John and his wife, Helen, managed to convert the exchange to dial. This was all done in spare time, on weekends, holidays. This was a hobby?

With the exchange converted, the real problem moved into view. Happy, now, were the 16 formerly irate subscribers, but in their place stood 100 equally irate applicants, all seeking rural service. The cash reserve was all gone; there seemed nowhere to turn. Then John and Helen attended the 1958 Oklahoma Telephone convention and discovered the Stromberg-Carlson Credit Corp. Working with Frank Micka, area Stromberg-Carlson sales representative, John made plans to expand the Pearson exchange and to start a new exchange at nearby Tribbey.

Soon the first additional phones were installed with Credit Corp. money; the station count crept upward, to more than 100 at Pearson alone. At Tribbey, a town of 200 which had been without phone service for thirty years, a dial building began to rise.

To sell or to keep?

Now came the time for decision. Working part time, John Hines had developed his company to the point where it was making a small but steady income. This was the time to drop the double life, sell out, and relax a little. After all, he was IBM's leading salesman in his five-state district for both 1957 and 1958. If this record was to continue, the telephone company had to go.

But it didn't.

Instead, John bought the neighboring Earlsboro exchange. In July 1959, he quit his IBM job and moved his family out of their big new home in Oklahoma City and into the house that went with the Earlsboro exchange. What a house! As John said, "Our roof has useful holes in it—big enough to see through." His wife, Helen, put it a little differently: "With that roof like it is, and the cracks in the floor, at least we can say we have cross ventilation."

Helen volunteered to run the switchboard to cut costs. John plunged himself into the work of reconstructing the company and, more important, the challenge of rebuilding the town itself.

He became a one-man Citizens' Committee, then a leader of many civic groups as others caught his enthusiasm. Only a dedicated telephone man would have sacrificed what John did to pipe life into Earlsboro. As Frank Micka, Stromberg-Carlson sales representative, put it after a visit to the rebounding town:

"I never saw a man so much in dead earnest as John Hines. He picked this town up off the ground and is running with it on his shoulders."

A new federal law permitted the town to take bankruptcy and reduce the town debt to manageable size. New wells were drilled to improve the water supply. A chamber of commerce, known as the "Earlsboro Boosters," was organized and started to work on many civic improvements. Just last September the town was converted to common battery with a used Stromberg-Carlson board which Frank Micka located. 1543W dial phones were used, to be ready for the XY® Dial system on order.

Subscribers needed

New families moved into the vacant homes. Long-closed streets were reopened to traffic. Two county seats, located within eight miles of Earlsboro, started growing industrially. The future of the town seems assured. As John Hines puts it, "We have a good town to live in, fine schools and churches, plenty of available land with water, gas and telephone service. If the Earlsboro Boosters can just keep up the good work, we'll get back to that population of seven thousand."

John called the other day, said he was too busy to talk for long. Seems he had told the other merchants in town that if they would cooperate in securing Christmas lights and decorations for the main street, he and his linemen would install them. And erect a 25-foot tree in the town as well. Earlsboro was about to be well lit in festive mood—perhaps for the first time since the whiskey boom!

Schedule Vote on Merger Of Two Canadian Companies

Shareholders of Northern Telephone Co., New Liskeard, Ont., were scheduled to vote on Dec. 21 on a proposed merger with the company's controlled subsidiary, Norwesto Enterprises Ltd., Kenora, Ont.

Norwesto and its wholly owned subsidiary, Norwesto Communications Ltd., provide telephone service (specializing in radio telephone) over a large area of northwestern Ontario.

The Northern company serves an area in northern Ontario and northern Quebec having a population of about 205,000.

Since 1956, the Northern company has held 52 per cent of the stock of Norwesto Enterprises.

Norwesto shareholders will be offered two shares in the merged company, to be called, Northern Telephone Ltd., for every three shares of Norwesto.

Taylor Elected Trustee Of Teachers Insurance

Jacob B. Taylor, executive vice president—finance of General Telephone & Electronics Corp., has been elected a trustee of Teachers Insurance & Annuity Association, R. McAllister Lloyd, chairman of TIAA, has announced.

Mr. Taylor succeeds Earle S. Thompson, chairman, West Penn Electric Co., to the trusteeship.

Before joining General in October, 1957, Mr. Taylor had been vice president, business manager, and treasurer of Ohio State University, with responsibility for the university's finances and investments. He formerly had served as professor of accounting and head of the accounting department at Ohio State, and on the faculty of the University of North Dakota.

Mr. Taylor is a past President of the American Accounting Association, of the Central Association of College & University Business Officers, and of Beta Alpha Psi. He is co-author of several accounting textbooks.

TIAA is a nonprofit organization founded by the Carnegie Corp. and the Carnegie Foundation for the Advancement of Teaching. It provides retirement, life insurance, medical expense insurance, and disability insurance plans for nearly 1,000 colleges, universities, independent schools, foundations and scientific and research organizations.

Obituaries

A. J. Parsons, former secretary-treasurer of the Illinois Telephone Association, died in November.

Mr. Parsons was a pioneer Illinois telephone man. He started to work in 1884 as a messenger for the American District Telephone Co. in Chicago.

In 1885, he became associated with the CB&Q Railroad as messenger and as telephone operator and remained with them for three years. He continued in the telegraph industry and was employed by the Denver & Rio Grande Railroad in Colorado, and by the Western Union Telegraph in Salt Lake City and in Chicago.

Mr. Parsons took a post with the American Telephone & Telegraph Co. in Chicago in 1897. He was manager of the Central Union Telephone Co. at South Bend, Ind., in 1905 and two years later, went to Chicago as connecting agent for the company.

In 1927, he was general manager of the Illinois Southern Telephone Co.; and in 1929, he was elected treasurer of the Illinois association, a position he retained until his retirement in 1944.

Mr. and Mrs. Parsons celebrated their 66th wedding anniversary on Oct. 19. Mrs. Parsons survives.

•

Dr. Oliver E. Buckley, 72, retired president and chairman of the board of the Bell Telephone Laboratories, Inc., died on Dec. 14 in Newark, N. J.

Dr. Buckley retired from the laboratories in 1952 after a 38-year career. Known as an outstanding scientist and administrator of research, he was a pioneer in submarine telephony. His research led to the laying of the transoceanic telephone cables which connect the U. S. with Europe, Hawaii, Alaska and Cuba.

He was a member of the general advisory committee of the Atomic Energy Commission from 1948 to 1954, and served as the first chairman of the science advisory committee of the Office of Defense Mobilization.

For World War II services, Dr. Buckley received the Medal of Merit, the nation's highest civilian award. He received the Edison Medal in 1954 from the American Institute of Electrical Engineers.

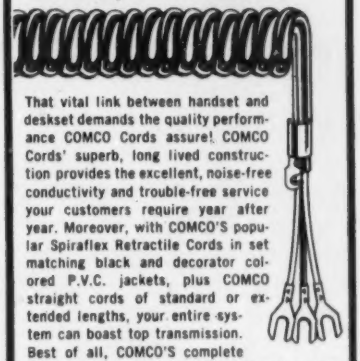
Dr. Buckley was a native of Sloan, Ia., and a graduate of Grinnell College. He earned his doctorate at Cornell University.

His career in telephony began as a research physicist with the Western Electric Co.

Survivors include his wife, Mrs. Clara Lane Buckley; a son, William D.; three daughters, Mrs. Katherine B. Nuekolls, Mrs. Frederick B. Wolf, and Mrs. Patrick S. Alsup; three sisters, Mrs. A. F. Shull, Mrs. Thomas Mills, and Miss Dorothy Buckley, and 11 grandchildren.

WHAT'S MISSING?

His COMCO Spiraflex Retractile Cord, of course!



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Happy New Year

By Mayme Workman

A NEW YEAR IS like a fresh white sheet of paper upon which nothing has been entered. It is available to the user for whatever purpose he designs. The old year, like a used sheet of paper, is ready to be discarded. It has served its purpose and will soon be just a memory.

As the Old Year slips into oblivion, his shoulders bent with the burdens and cares of his short span of life, we give him the brush-off and welcome the little newcomer with shouts of welcome and joy. Forgotten are the disappointments, heartaches and trials of the old year as we look forward to 1960 and what it holds in store for us.

New Year's Resolutions, an important part of the lives of our parents and grandparents and their children, have become outmoded. However, since the dawn of a New Year is still inventory time for many firms and their employes, it is also a favorable time to take inventory of our personal lives during the past year and to make plans for the year 1960.

The New Year arrives with rich materials that give value to life, and it is up to us to plan how we shall use these blessings, in our work and in our personal lives.

As telephone folk, we, too, can take inventory of the service we have rendered to our customers in the past year.

What effort have we put forth to improve the service which resulted in creating favorable customer reaction?

Has our speed of service increased or decreased?

Have our service criticisms minimized or increased?

After taking a careful inventory of the service we have given in the past year, we should go a step further in our appraisal and take stock of ourselves, for without a thorough knowledge of ourselves, we can never come to an understanding of the world in which we live and in which we are working to make our life a success.

In taking stock of ourselves, we should first of all determine our capabilities, both physical and mental, as well as our limitations. Next, we should ask ourselves:

Are our aims and ambitions worthy of the individual we would like to be?

What part in our life is governed by our likes, dislikes and prejudices?

What is our general effect upon others?

In other words, is our personality working in our favor or against us?

In making this analysis, it is well to bear in mind that knowledge and skill, combined with a pleasing personality, will inevitably bring success to an individual in any line of business.

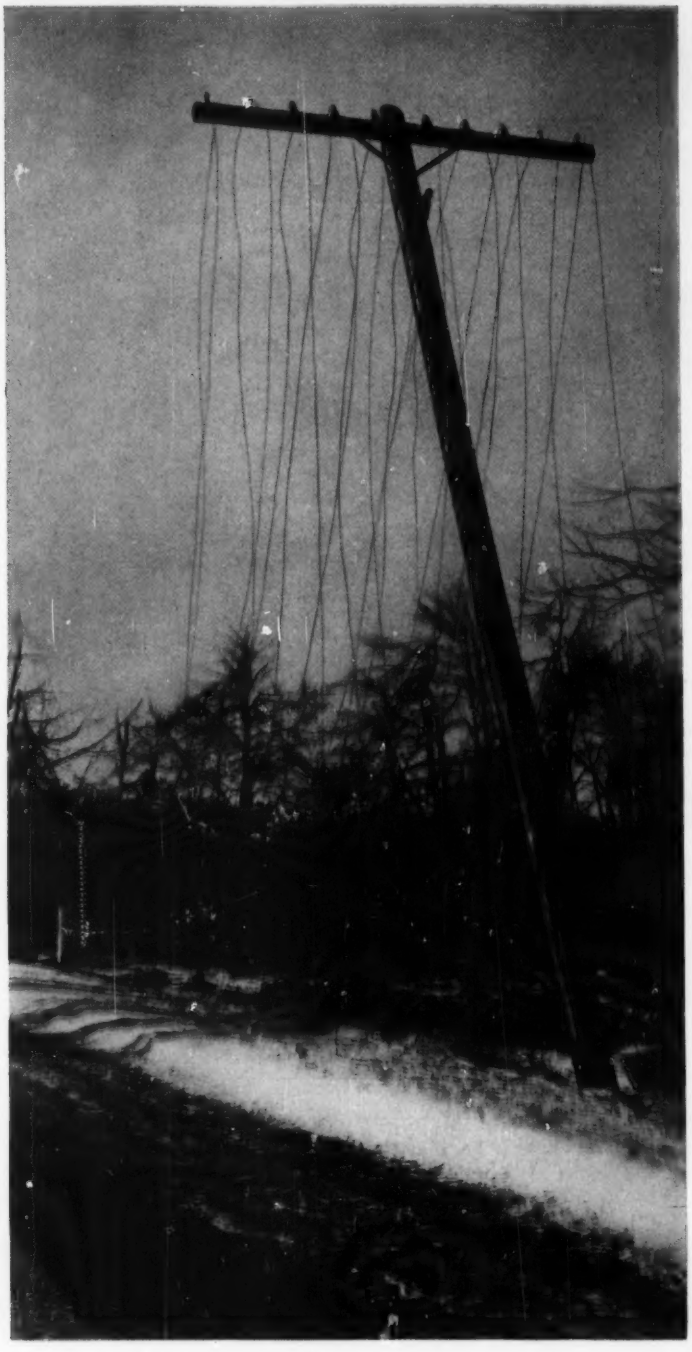
Everyone enjoys contact with a cheerful person. A cheery disposition is like air in a tire. There really doesn't seem to be much to it, but it makes the going easier and happier for everybody. The rougher the road, the more we need it.

The prospects for 1960 are good. We are at peace with all nations. Our living standards are the highest in the history of our country. While we look forward to the enjoyment of all of these blessings, it is well to remember this situation could change over night, particularly if we become selfish and self-centered—if we fail to be thankful for our many blessings.

Our closing New Year's thought and wish is that peace and understanding will continue to prevail in our beloved country and in all peace-loving nations throughout the world.

May the New Year truly be a happy one for each of you. May your lives be filled with many blessings and your paths flooded with sunshine, and may God smile upon you through the year.

Rely on Graybar...



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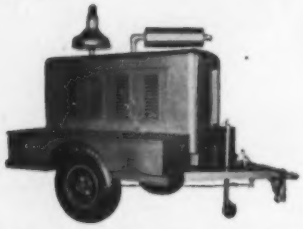

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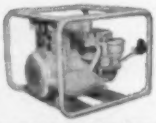

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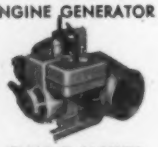

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A HISTORY OF TRANSMISSION SYSTEMS

Continued from page 25

be obtained for the price of two—a very significant savings indeed.

Fig. 6 shows how a phantom works. The two metallic circuits (1) and (3) are called the "physical" or "side" circuits. Together with the phantom circuit (2) they make up a phantom group.

In side circuit (1), voice currents produced in the transmitter are induced by the coil onto the line wires (a) and (b). They flow around the circuit and through the receiving coil which induces corresponding currents in receiver (1). The same action takes place in side circuit (3). In the phantom circuit (2), however, the voice currents are connected to the exact midpoint of the side circuit line coils. They divide equally and flow over both wires of each pair of side circuits. Being equal, they balance each other in receiving coils (1) (3) and induce no current in the side circuit receivers. The phantom currents combine through the midpoint connections and flow through the phantom coil which induces corresponding currents in the circuit (2) receiver.

The key to proper operation of a phantom group is the precision with which the line wires and coils are balanced. Any unbalance permits currents from the side circuits to leak into the phantom and vice versa. These unwanted currents make the circuits noisy, or in severe cases, actually allow the conversation on one circuit to be heard on the other. This phenomenon is called crosstalk.

Suitably balanced circuits proved difficult to make. While phantomizing was devised by Frank Jacob in 1882 and J. J. Carty's patent covering the present method was granted in 1886, it took another 16 years to produce the first successful phantom circuits.

An even more wraithlike circuit, called a ghost, was tried. This effectively derived a second phantom from a pair of phantoms. Maintaining satisfactory balances, however, proved completely impractical.

Carrier

A totally different approach to efficient circuit utilization became a practical reality in the 1912 to 1918 period. This was carrier current telephony. Commonly called carrier, it is a technique which places several telephone conversations one on top of the other in the frequency spectrum. This is illustrated in *Fig. 7*, which shows how four conversations or circuits can be stacked in a frequency band 16 kilocycles wide. A pair of wires capable of transmitting this 16-kilocycle frequency band can thus carry four separate circuits simultaneously.

The concept was as old as the telephone itself. In fact, Bell was trying to perfect a harmonic carrier telegraph system when he invented the telephone. Many systems were proposed both here and abroad in the late 1800's and early 1900's. As with the phantom, however, it was not the theory that was lacking, but the equipment needed to apply the theory.

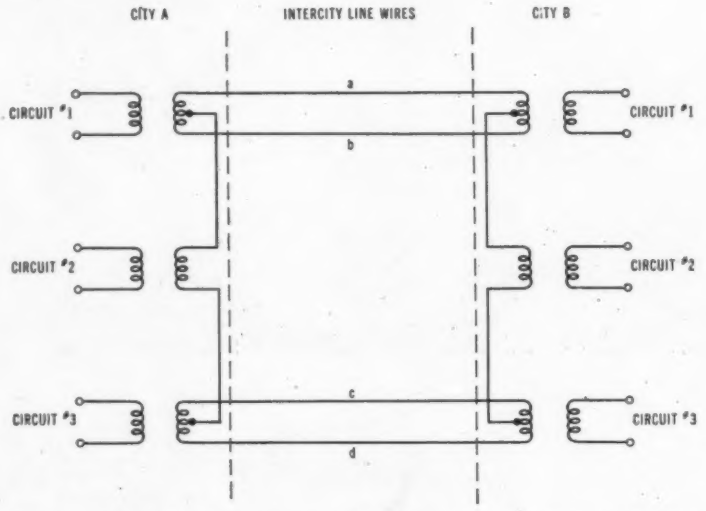

Fig. 6. The basic phantom group consists of two physical circuits (1) and (3) on either side of the phantom circuit (2).

Some formidable obstacles had to be overcome before practical carrier telephone systems could be built. First among these was the fact that telephone circuits could then transmit little more than the two or three kilocycle band of frequencies required for one conversation, much less additional bands of frequencies for a second or a third. Second,

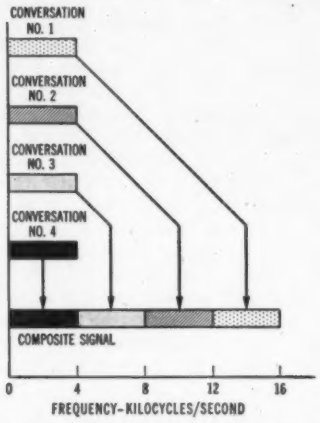

Fig. 7. Stack of carrier frequencies.

means had to be found to move, or translate, the frequencies associated with a telephone conversation into some other place in the spectrum. This frequency translation process is called modulation. And, finally, devices were required which could differentiate between each of the bands of frequencies being transmitted and separate them into individual circuits again at the receiving end.

The high-vacuum triode made possible the solution to both the first and second problems. It provided sufficiently great amplification to

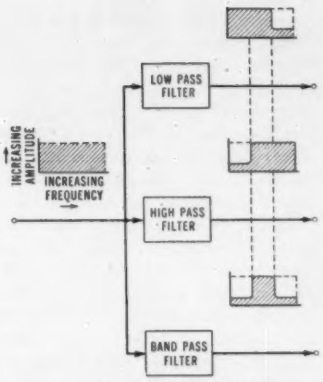

Fig. 8. Three basic filter types.

overcome circuit losses and permit the transmission of wide frequency bands. It also provided a means of accomplishing frequency translation.

This latter area is of particular interest. It was found that speech frequencies could be shifted to other parts of the spectrum by superimposing or carrying them on another frequency. Hence, the name carrier. Vacuum tube oscillators were used to generate the required carrier frequencies and vacuum tube modulators were constructed which superimposed speech frequencies on the carrier frequencies.

Still another invention was needed, however, before successful carrier systems could be built. This was the electric wave filter, invented in 1915 by G. A. Campbell. It made use of the fact that a coil or inductance impeded electric current flow more and more as the frequency of the current was increased, while a capacitor acted in exactly the reverse manner.

By arranging coils and capacitors in various networks, three basic

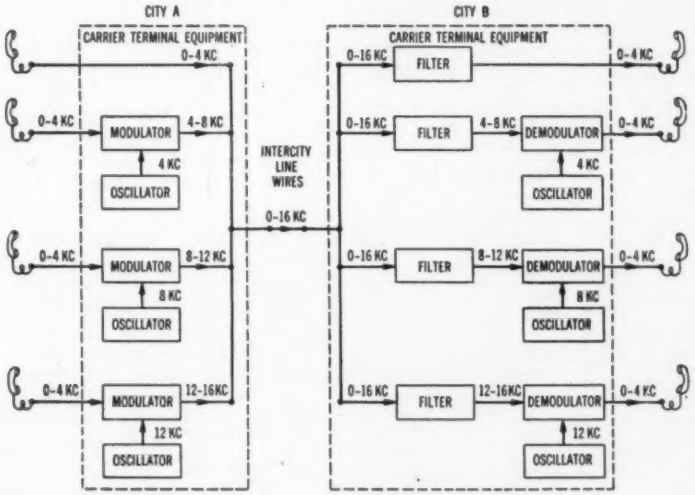

Fig. 9. Simplified block diagram of the operation of a carrier system.

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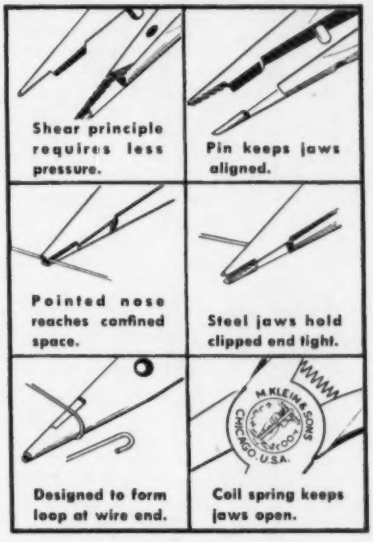
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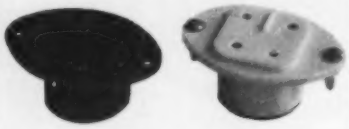

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types of filters could readily be produced. One type passed low frequencies and cut off the flow of high frequencies. A second type passed high frequencies while cutting off low frequencies. The third type was a combination of the other two. It passed only a small band of frequencies, cutting off the flow of all frequencies above and below the pass band. The action of these three basic filter types is diagrammed in *Fig. 8*. Filters made it possible to differentiate between the bands of frequencies associated with several conversations when they were transmitted simultaneously.

Fig. 9 is a simplified block diagram showing the operation of a carrier system. Although carrier systems can provide from one to hundreds of circuits depending on their design, four circuits are shown. Each circuit is assumed to carry a nominal band of frequencies from zero to 4,000 cycles per second (zero to four kilocycles). This is sufficient for high quality speech transmission.

As shown in the diagram, the speech frequencies of circuit (1) are fed directly to the line wires where they occupy their normal position of zero to four kilocycles. Circuits (2), (3) and (4), however, have associated modulators and oscillators. The oscillator for circuit (2) generates a steady frequency of four kilocycles. This is fed into the modulator where it is mixed with the speech frequencies. The result is that a frequency of four kilocycles is added to each speech frequency (e.g., a speech frequency of 250 cycles becomes 4,000 plus 250 cycles or 4,250 cycles). The output of the modulator is, therefore, a frequency band of four to eight kilocycles. In a similar fashion, circuits (3) and (4) are translated to occupy frequency bands of 8 to 12 kilocycles and 12 to 16 kilocycles, respectively.

Thus, the four circuits now represent a continuous band of frequencies from zero to 16 kilocycles which can be transmitted over the line wires to the receiving end where the reverse process called demodulation takes place. Filters separate the line frequency associated with each circuit.

Circuit (1) again requires no frequency translation. For circuits (2), (3) and (4), demodulators and associated oscillators are used to shift the line frequencies back to the normal zero to four kilocycle range. The equipment required for the entire sequence of operations is, of course, all duplicated to provide the return speech paths from right to left.

Unlike the phantom, the terminal equipment for carrier telephone systems cost a significant amount of money. For carrier to be economically attractive, therefore, it had to be used on long circuits where equipment costs were less than the price of additional wires on the line.

The first experimental carrier system was installed on the Tuxedo-Brushton line (now defunct central offices outside Baltimore and Pittsburgh, respectively) in 1918 and provided four circuits over one pair of wires between Pittsburgh and Baltimore, a distance of about 230 miles. This system, later coded Type A carrier, was followed shortly by Type B, a three-channel carrier system. These systems found their most economical application for circuits from 250 to 300 miles long and by the mid-1920's more than 50,000 circuit miles of carrier were in service.

In 1926, an improved three-channel carrier system, Type C, was introduced. It incorporated economies which made it attractive for circuits as short as 150 miles and had vastly improved performance over its predecessors. Truly a forerunner of systems to come, Type C carrier was installed in large quantities for more than 20 years. It was even repackaged for military field use during World War II. Many circuit miles of C carrier still furnish dependable service.

At the same time that C carrier was developed, work was underway to produce a system that would be economical over even shorter distances. The resulting Type D carrier system provided one carrier channel (in addition to the voice circuit on the pair of wires) at a low initial cost and with sufficiently high stability that little maintenance expense was required. This system was attractive for circuits about 50 miles or more in length. Two other single channel, short-haul systems, coded Type G and Type H followed soon after.

An important invention was made in 1927 by H. S. Black, which vitally affected the future of carrier telephony. This was the negative feedback amplifier. This amplifier was capable of stable amplification of much wider bands of frequencies than had been heretofore possible, thus permitting more carrier channels to be superimposed on a single pair of wires.

With the availability of negative feedback amplifiers, by the mid-

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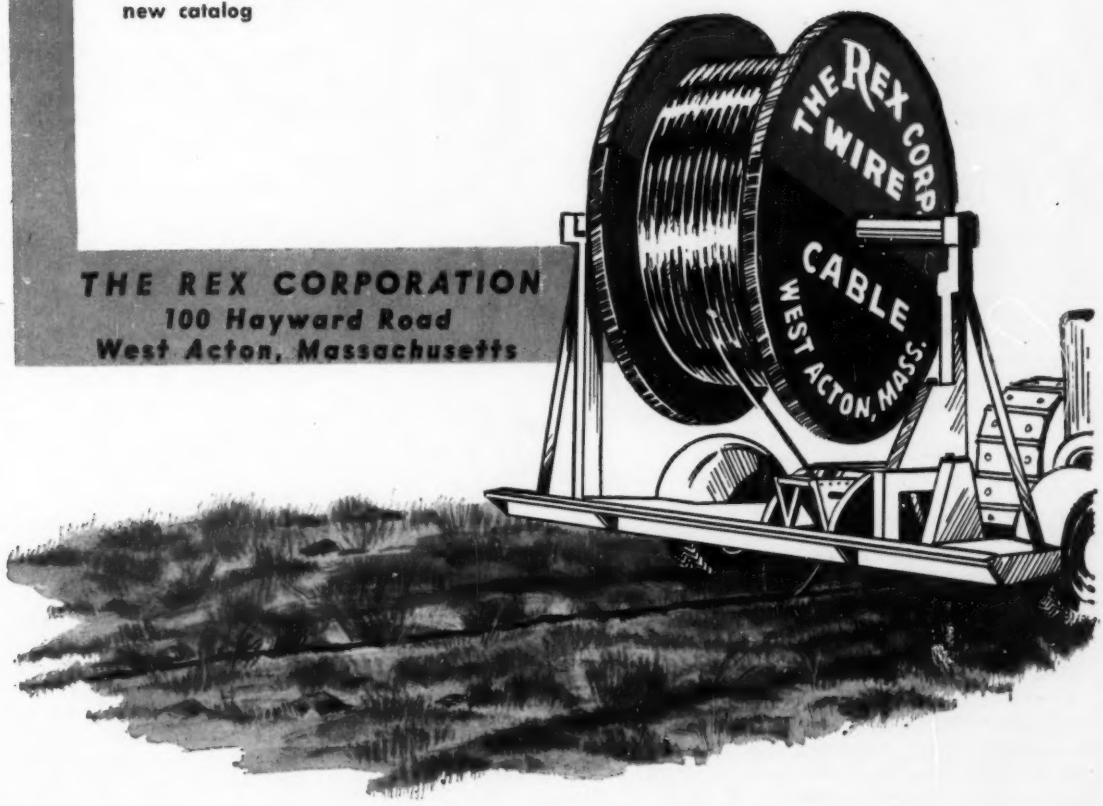


1930's development work was largely completed on the first of the so-called "broad band" carrier systems. Two types were quickly put into service. One, called Type J, provided 12 channels on an open wire pair. The other, called Type K, was developed for use on toll cables. It also provided 12 channels, but required two cable pairs, one for each direction of transmission.

Both of these carrier systems used two frequency translations or steps of modulation. The first step in each case was to combine 12 voice circuits into a band of frequencies extending from 60 to 108 kilocycles. An equipment unit called a channel bank was developed for this purpose. The channel bank made use of very low loss piezoelectric crystal filters to separate the voice circuits and made provision both for the initial step of modulation in the talking or sending direction and the final step of demodulation in the listening or receiving direction.

In the J carrier system, the 60 to 108 kilocycle output of the channel bank was translated a second time to a new position in the frequency spectrum between 36 and 84 kilocycles for one direction of transmission, and between 92 and 140 kilocycles for the other direction. Thus, a pair of wires on an open wire line, suitably balanced, could carry both directions of transmission, or sides, of the entire 12-channel J carrier system. Separate amplifiers and terminal equipments were, of course, required for each direction.

In K carrier, because of the higher loss of cable circuits, it was difficult to transmit separate frequency bands for the two directions of transmission. Instead, two pairs of wires in separate cables were used, one for each direction of transmission. The second step of modulation in this case translated the channel bank output to a band of frequencies between 12 and 60 kilocycles for use in either direction of transmission.

Coaxial Cable

The coaxial cable system, invented in 1929 by L. Espenschied and H. A. Affel of the Development and Research Department of AT&T, was capable of carrying even wider bands of frequencies than either open wire or cable circuits. This meant that more circuits could be carried. A new broad-band carrier system, called Type L, was developed to make use of the extremely wide bandwidth of the coaxial cable.

Type L carrier was the next evolutionary step after Types J and K. It made use of the same basic channel bank equipment to perform the first frequency translation of a group of 12 voice circuits.

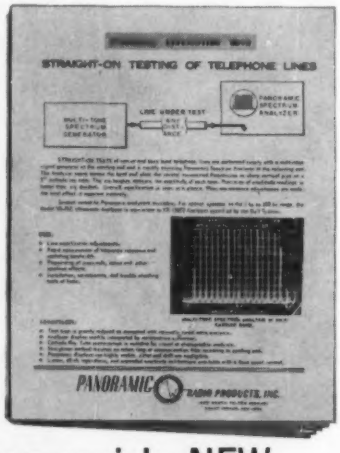
Two additional frequency translations, for a total of three, were used before reaching the coaxial line. Each 12-channel group passed through a group modulator and the output of five group modulators was further combined in the final step of modulation into a supergroup. The supergroup, made up of 60 voice channels, was the new building block of the L carrier system. As many as 10 supergroups (600 voice channels) could be carried on one coaxial circuit.

The first coaxial cable, equipped with Type L carrier was placed in commercial service between Stevens Point, Wis., and Minneapolis in 1941. This was a distance of about 195 miles. Thousands of miles of coaxial cable now crisscross the United States. These are equipped with either Type L carrier systems or, in some cases, with special equipment which makes use of their broad bandwidth to transmit television signals. On some of the very heavy routes, a later version of Type L carrier, called L-3, is used to provide hundreds of additional circuits. This system requires two more steps of modulation to combine 10 supergroups into a mastergroup and further combine three such mastergroups to make a total of 1,800 voice channels in the system.

Paralleling the development of long-haul systems capable of efficiently carrying hundreds of conversations was the development, in the Bell System and in other companies, of smaller, more economical systems for shorter distances such as N, O, and ON systems. This included carrier systems capable of superimposing telephone conversations safely on the wires of electric power lines for providing service to remote rural areas.

The carrier principle has also been applied to radio transmission, as exemplified in the TD-2 microwave radio relay system.

Research has also explored other principles of multiplexing such as pulse code modulation (PCM) and time sharing techniques. PCM systems provide multi-channel service by sequentially sampling each of a group of conversations, transmitting the information of each sample over the circuit in turn, and reassembling



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the samples into individual conversations at the other end. Pulse modulation systems have been in use for some time. New methods and materials are making it possible to design PCM systems which can be used on local circuits a few miles long—circuits now needing individual cable pairs.

The first practical time sharing system, called TASI, will enter service on the transatlantic telephone cable next year. It will about double the cable's capacity by making use of idle time (on an average, speech time amounts to somewhat less than half of total conversation time).

Despite the tremendous progress made in telephone transmission systems to date, the future promises possibly even greater change. Building on now-classic principles, channel capacity will be increased by use of higher operating frequencies to permit telephone users to see as well as hear each other, to meet the need for long distance data processing operations, and to take care of the ever increasing number of ordinary conversations. Revolutionary types of electronic components will be needed and conventional cable may be superseded by waveguide. The problem of the horizon in long distance radio transmission may be solved by bouncing broad-band signals off satellites. And the space age may call for types of transmission service even more revolutionary.

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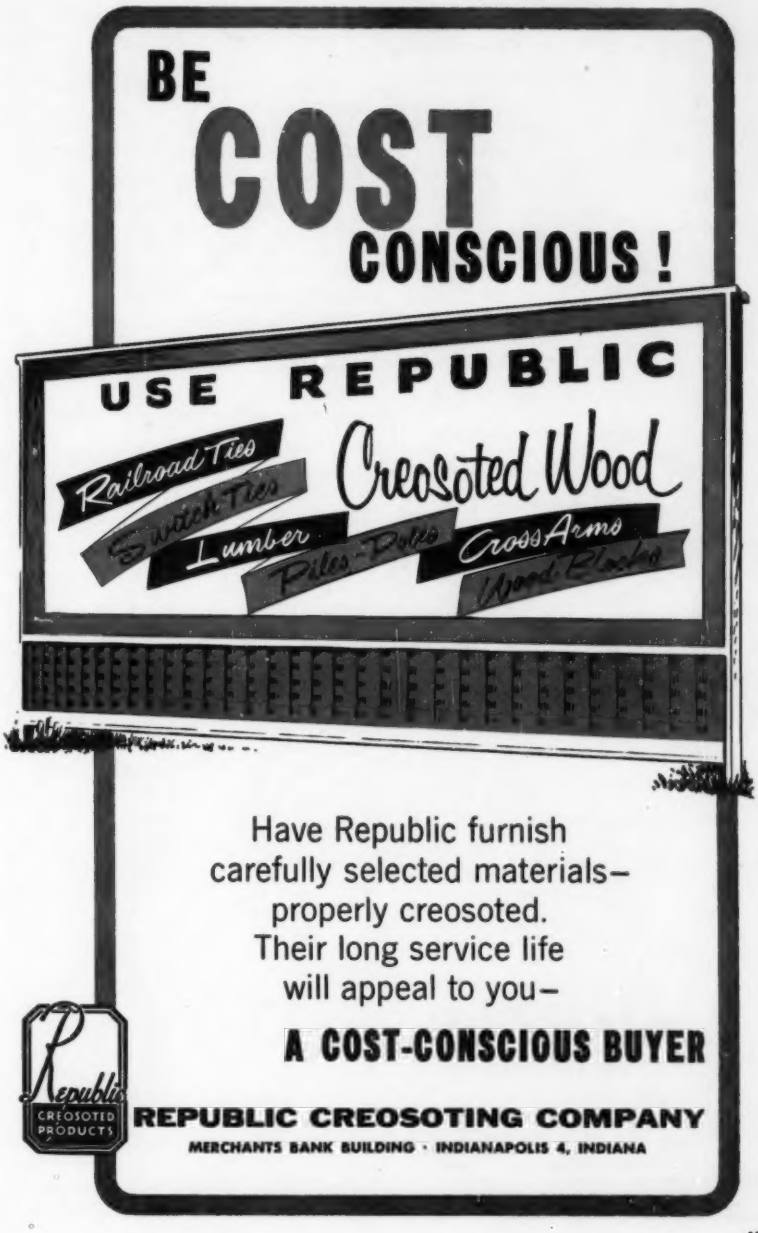

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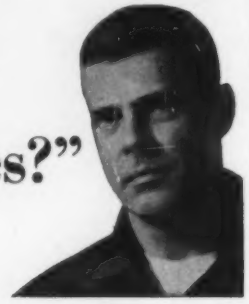

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WHEATSTONE BRIDGE MEASUREMENTS

Continued from page 19

of the values obtained for Xa and Xb when making a three Varley measurement, is that when added together they should equal Xc. For example, in *Fig. 4*, 31.5 + 62.6 = 94.1.

In computing the distance in feet to the fault, allowance is usually made for the difference in temperature within the cable at the time the test is made in determining the fault location. The resistance of copper wire varies approximately 1 per cent for each four degrees change in temperature, therefore, an appreciable error in the fault location may result unless the temperature factor is taken into consideration.

In the above case, it is assumed that the temperature within the cable section in which the fault is located, is 68 degrees Fahrenheit. Then referring to the temperature constant *Table 1:*

(1) Under the heading 22, and in line with 68 under the heading degrees Fahrenheit, is found 62, which represents the feet per ohm (FPO) of the 22-gauge cable.

(2) To obtain the distance in feet from the strap "S" at the cable terminal back to the fault, Xa is multiplied by the (FPO), or 62 × 31.5 = 1,953.

(3) Distance in feet from the testing point to the fault is equal to FPO × Xb, or 62 × 62.6 = 3,981 feet.

(4) Total length of the bad cable conductor equals FPO × Xc, or 62 × 94.1 = 5,834 feet.

(Note: In cases where the good, bad, or both, cable pairs are loaded, the resistance of the loading coils must be subtracted from the R1, R2, and R3 readings in order to obtain the actual resistance of the cable conductors.)

In exchange areas, where cable fault locating by means of the Wheatstone Bridge measurements is regularly practiced, the temperature at any time within a cable may be determined as follows:

(1) Obtain a vacant pair in a cable that can be permanently short circuited in the cable terminal at the distant end.

(2) Measure the loop resistance.

(3) Subtract the resistance of the leads between the Wheatstone Bridge and cable pair.

(4) Divide the remainder by 2. The result will equal the resistance of one

Constant For Various Temperatures	Feet Per Ohm For Size of Copper Wire Usually Used in Telephone Cables					
Degrees Fahrenheit	19	20	22	24	26	28
100	115.4	91.5	57.5	36.2	22.7	14.4
95	116.8	92.6	58.3	36.6	23.0	14.5
90	118.2	93.7	59.0	37.0	23.3	14.7
85	119.6	94.8	59.6	37.5	23.6	14.9
80	120.9	95.9	60.3	37.9	23.9	15.0
75	122.2	96.9	61.0	38.3	24.1	15.2
70	123.6	98.0	61.7	38.8	24.3	15.3
68	124.1	98.4	62.0	38.9	24.4	15.4
65	125.0	99.1	62.3	39.2	24.6	15.5
60	126.3	100.2	63.0	39.6	24.9	15.7
55	127.7	101.2	63.7	40.0	25.2	15.9
50	129.0	102.3	64.4	40.5	25.4	16.0
45	130.4	103.4	65.0	40.9	25.7	16.2
40	131.7	104.5	65.7	41.3	26.0	16.4
35	133.1	105.5	66.4	41.7	26.2	16.5
30	134.4	106.6	67.1	42.2	26.5	16.7
25	135.8	107.7	67.7	42.6	26.8	16.9
20	137.1	108.7	68.4	43.0	27.1	17.0
15	138.5	109.8	69.1	43.4	27.3	17.2
10	139.8	110.9	69.8	43.9	27.6	17.4
5	141.2	112.0	70.4	44.3	27.8	17.6
0	142.5	113.0	71.1	44.7	28.1	17.7
— 5	143.9	114.1	71.8	45.1	28.4	17.9
—10	145.2	115.2	72.4	45.6	28.7	18.1
—15	146.6	116.3	73.7	46.2	29.0	18.3

Table 1—Temperature constant table

conductor of the cable pair between the central office and distant cable terminal.

(5) Divide the length of the cable conductor by the remainder obtained in Item 4.

(6) The result of the final division will equal the temperature within the cable and may be used in connection with the temperature constant *Table 1*, to obtain the desired feet per ohm of any gauge cable listed.

Example: Suppose the combined loop resistance of the cable pair and the Wheatstone Bridge test leads is 243 ohms:

(1) Assuming the resistance of the test leads equals 3 ohms. Then, 243 — 3 = 240 ohms, the cable pair loop resistance.

(2) 240 ÷ 2 = 120 ohms, the resistance of one cable conductor.

(3) If the cable length is 8,824 feet, allowing 2 per cent for additional length of the conductor within the cable due to spiraling, the actual length of the conductor equals 8,824 + 176 = 9,000 feet.

(4) 9,000 ÷ 120 = 75 degrees.

(To Be Continued)

IN THE NATION'S CAPITAL

Continued from page 14

reclassifications based on the number of private line services used between the same points by the same agency.

The other important case, which is still technically before the FCC on petition for reconsideration, is the private microwave policy decision of last July. The telephone industry has asked the FCC to reconsider the impact of this decision, whereby a proposed allocation of microwave frequencies would be available for almost unrestricted licensing of private microwave systems. The telephone companies feel that this policy will have a damaging effect on the customers of common carrier (Telephone company) services. A number of others apparently feel the same way.

At its national convention in Philadelphia last October, the National Association of Railroad and Utilities Commissioners (NARUC), authorized its special telephone committee to investigate this situation. And, more recently, the president of the NARUC, George R. Perrine has written to FCC Chairman Doerfer asking that the FCC reconsider its microwave policy decision and urging that the FCC re-establish a licensing policy for private point-to-point communications systems which would make available adequate frequencies to the regulated telephone companies, and protect their customers from the damaging effect of unre-

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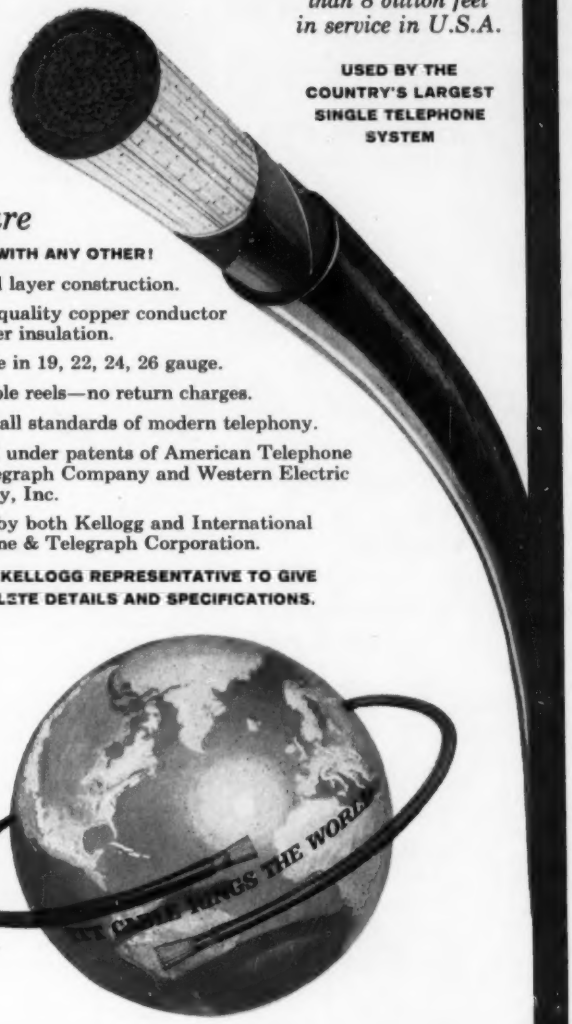

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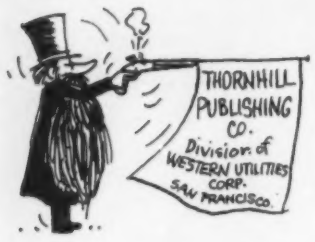

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stricted licensing of private microwave systems.

On still another front, the telephone advisory committee of the REA has recommended that REA Administrator Hamil determine whether the proposed microwave frequencies for private point-to-point facilities (other than common carrier) would have a crippling effect on the security of REA loans to rural telephone borrowers. This action, of course, also referred to the FCC decision of last July.

Another important utility group has shown a vital interest in this matter—the American Gas Association (AGA), which has expressed concern about the possibility of gas utility and pipeline companies losing private point-to-point frequency rights. In a recent conciliatory communication to AGA headquarters, NARUC President Perrine pointed out that the state commission association has no intention of doing anything to deprive the gas or other non-telephone utility users of microwave systems of licensing rights in this field.

What all this renewed agitation—following the original decision of the FCC last July—points up is the possibility that the FCC might take another long look at its controversial policy, before going ahead with plans to allow unrestricted point-to-point private microwave licenses.

Campaign Oratory

Even the most cursory reference to what is ahead for 1960 would be incomplete without some consideration of the presidential election and its impact on the congressional session and possibly on public utility industries. As to the former, it is likely that the coming wide open presidential contest will have a somewhat depressing effect on congressional activities during the coming session, which starts next month. The session itself is likely to be shorter than the summer long session of the past three years. The 1960 session must wind up by early July in time for the national conventions of the two major parties.

Again, there is a tendency for Congress to avoid unnecessary controversial action during an election year. Routine appropriations bills will have to be considered, of course. President Eisenhower may demand that something be done about emergency strike legislation if the steel dispute reverts to its previous stalemate after the 80-day Taft-Hartley injunction period expires. On tax legislation, farm aid, health, education, and welfare bills, and a host of other political hot potatoes, Congress is likely to stall during the 1960 session.

Don't be surprised if Congress ducks even the proposed increase in the minimum wage standard of the Fair Labor Standards Act. At the last session, efforts of the labor unions to obtain an increase (and incidentally to do away with the small exchange telephone operator wage exemption) were deferred until too late for action. Whether Congress has any more determination to wrestle with the problem in 1960 is questionable. This writer thinks, however, that the demands of the labor unions have been put off too long, in this case, and that Congress will have to come to grips with the situation one way or the other. He could be wrong, of course, just as he was last year.

As for the public utility industries themselves, they can expect to hear their names mentioned in campaign oratory—particularly the electric utilities—at local levels. On the Democratic side the so-called liberal element, favoring expansion of federal government activity in the power field, is laying plans to put a strong public ownership plank in the party's platform. If that occurs—regardless of who the Democratic nominee will be—the left-of-center campaign orators will feel almost obliged to talk about the "power trust" and the misdeeds of big business in general. This has all happened before. But in 1960 it seems to be one of those things which the industry must expect. Criticism of increased utility rates will probably be dragged in here and there. Such is the unavoidable outlook in the superheated climate of the campaign year ahead.

Pritchett of Cal. Company Serving As President's Aid

E. K. Albert, president of the California-Pacific Utilities Co., with headquarters in San Francisco, has announced the appointment of D. M. Pritchett to the newly created position of assistant to the president.

Mr. Pritchett has been with the company since June, 1941 and has been personnel director since August, 1947. He will continue in charge of the company's personnel activities, and also work on special assignments for the president.

Golden Anniversary

The B. H. Piepmeiers of Black River Falls, Wis. celebrated their fiftieth anniversary on Dec. 1. Prior to his retirement in 1957, Mr. Piepmeier was president of the Community Telephone Co., and then, western division manager of the General Telephone Co. of Wisconsin, following the merger of the two companies. Since retirement, he has been active as a registered professional engineer.

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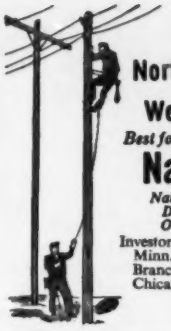

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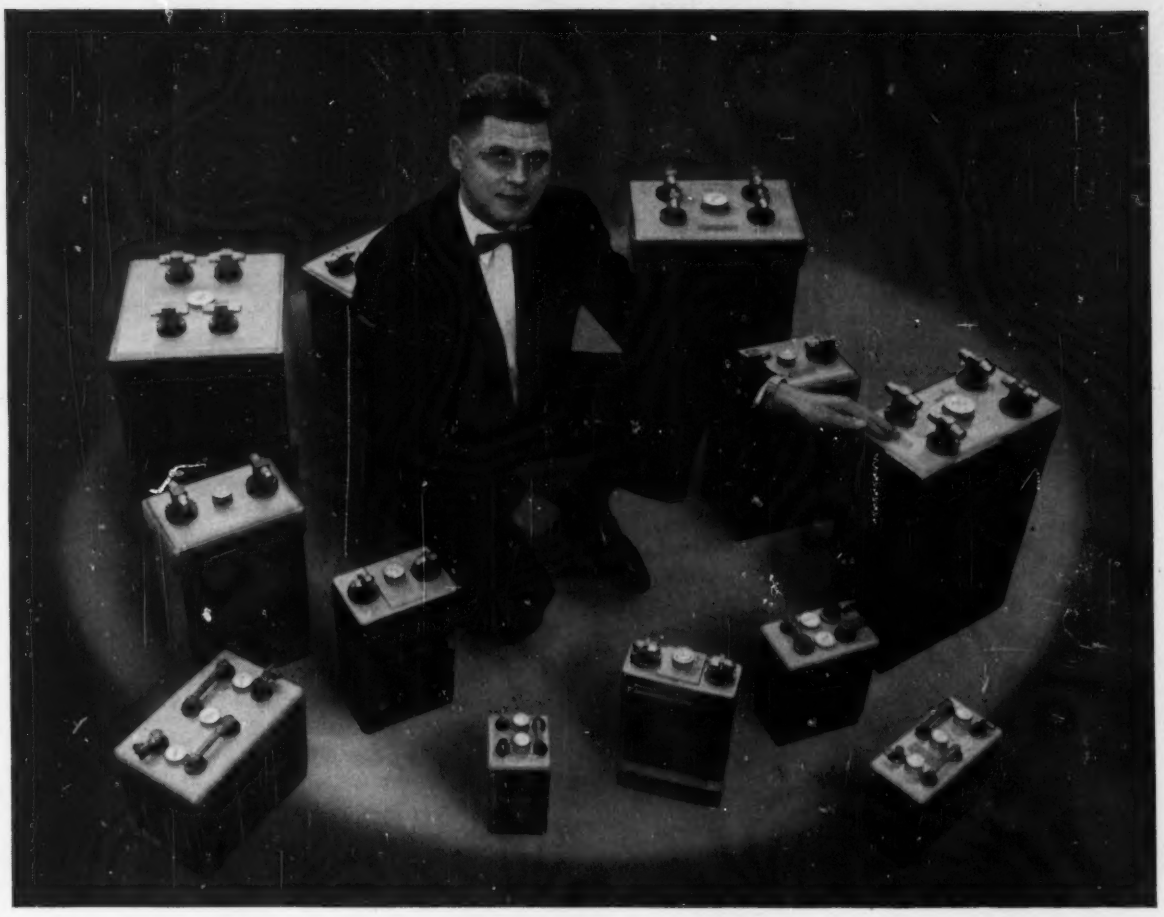

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